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Forthcoming Events.

JANUARY 8.

Institute of British Foundrymen (Sheffield Branch):—Ordinary meeting at Sheffield. "Casting Design," Paper by F. E. Edwards.

Institution of Mechanical Engineers:—Extra general meeting in London.

JANUARY 9.

Institute of British Foundrymen (Scottish Branch):—Ordinary meeting at Glasgow. "The Improvement of Cast Iron," Paper by C. H. Desch, D.Sc. After meeting, annual dinner.

Institute of British Foundrymen (Lancashire Branch):—Ordinary meeting at Manchester. "Liquid Shrinkage in Grey Iron," Paper by J. Longden.

Institute of British Foundrymen (West Riding of Yorkshire Branch):—Ordinary meeting at Bradford. "Aids to Production in the Foundry." Paper by J. Hogg.

JANUARY 12.

Sheffield Metallurgical Association:—Annual general meeting at Sheffield.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.
PRESIDENT, 1925-26: John Cameron, Kirkintilloch, near Glasgow.

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Welsh Engineers' and Founders' Association.
Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.
Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Introspective 1926.

The principal event in the foundry world this year is to be the second International Congress, to be held next autumn in Detroit City, U.S.A. Invitations have already been accepted by the premier foundrymen's organisations in Europe. The preliminary schedule includes New York, Philadelphia, Chicago, Pittsburg, Cleveland, Niagara Falls, and Washington. At the moment no less than 54 foundries and foundry equipment works, including the Ford Motor Company, have intimated their willingness to show their plant to the European visitors. The list takes in many other automobile foundries, whilst the shipbuilding, electrical, locomotive, speciality, steel and brass foundries represent the best America can show and whose products are widely known.

The next outstanding event of the foundrymen's 1926 is the London Convention. It is hoped to make visits to foundries the outstanding feature. The scheme envisaged is, roughly, a technical session on the Wednesday morning, the official visit to the exhibition in the afternoon, and the annual banquet in the evening. On the Thursday a second technical session in the morning, visits to London foundries in the afternoon, and a social event in the evening. The Friday of the Conference will be devoted to all-day visits to district foundries. Thus it is hoped to take one party to Luton, the second to Braintree, and a third to Letchworth. For the Saturday there may be a trip up the Thames. An influential reception committee has been formed, to which the following gentlemen have lent their patronage:—The Right Hon. Arthur Henderson, P.C.; Sir Alfred Mond, P.C.; Sir Robert A. Hadfield, Bart.; Sir Berkeley Sheffield; Sir Hugo Hirst; Sir William Larke; Sir John Prestidge; Engineer Vice-Admiral Sir Robert Dixon; and Brigadier-General F. E. Metcalfe, D.S.O.

Mr. H. G. Sommerfield is acting as the Hon. Secretary, and will shortly be launching an appeal for funds, as these conventions are becoming more and more ambitious each year. Both Newcastle and Glasgow raised something approaching £1,000, and this is the minimum sum with which the London Conference can be run. Should the reception committee's appeal fail to reach any firm or individual who has the work of the Institute of British Foundrymen at heart—for instance, some of those in the Dominions, who are proud to be associated with its work—they can send a donation to Mr. Sommerfield, whose address is given elsewhere on this page.

Associated with this Conference there is to be held a foundry trade exhibition at the Agricultural Hall, under the management of Mr. F. W. Bridges. The rather large Council of the Institute of British Foundrymen on the occasion of the recent Shipping, Engineering and Machinery Exhibition, had the opportunity of meeting Mr. Bridges and seeing something of the wonderful organisation he possesses as an exhibition promoter. He invariably stresses the importance of attracting to his shows the buyers of the industry represented. To this end he is inviting practically the whole of the technically-organised foundrymen of Europe. Space is rapidly being taken up, and already a very representative exhibition is assured. A strong committee has been formed, with representation from the National Physical Laboratory, the British Cast Iron Research Association, and the Institute of British Foundrymen, which will take care of the technical side of the exhibition.

Thus, from the technical side, 1926 promises to be one of outstanding importance, and all that is required for the complete success of these affairs

is reasonable trade conditions. After reading most of the forecasts in the great dailies, we gathered that if everybody worked harder (except, of course, foreign competitors), that if the Government Departments spent less, that if the mining situation can be reasonably adjusted, and that if shipbuilding will only increase in volume, really prosperous times would ensue. Foundrymen are aware, however, that trade improvement always "snowballs," and our forecast for 1926 is a general increase of business, differing from previous occasions by a lack of Government and municipal orders.

Mr. W. Roxburgh's New Appointment.

As announced in a recent issue, Mr. W. Roxburgh, who for 18 years has managed the foundries of the British Thomson-Houston Company, Limited, of Rugby, is joining the directorate of the Fordath Engineering Company (Glyso) of West Bromwich. His colleagues at the works arranged a smoking concert in his honour, and presented him with a gold watch, suitably inscribed, together with a present for Mrs. Roxburgh. Mr. R. Dumas, the B.T.H. works manager, presided over a large company, and in making the presentation, referred to the success which had attended Mr. Roxburgh's management of the foundry and pattern shop, both in regard to the quality of the output and his relationship with those under him.

Responding, Mr. Roxburgh, after thanking his colleagues, said the post of foundry manager was generally recognised by foundrymen as being one of the foremost posts in the British foundry world. Unfortunately, during his period of service the foundry had been too small, which obviously made his task more arduous. He understood, however, that the management were contemplating enlarging it. The specially designed souvenir programmes illustrating caricatured incidents in foundry life were a much-appreciated feature.

Foundry Query.

Liquid Iron Cement.

We shall be pleased to know if you can tell us of any liquid cement or fluid which we can use for floating inside hollow castings, so as to make them water-tight at any places that are slightly porous. These tanks may have to hold oil or soda water, and whatever substance is used for stopping the leaks must resist the action of these liquids.

We have heard that silicate of soda or water glass is sometimes used for rendering hydraulic cylinders that are porous, water-tight. The trials we have made have not been successful, possibly because we did not use the proper proportions or we omitted some other substance that should be mixed with the water glass. Some of the internal surfaces of the castings cannot be reached by hand. That is why we want something that can be floated to the place.

J. P. S.

Electric Furnaces in 1925.

The Admiralty have recently placed an order for an annealing furnace of the resistance type with the Electric Furnace Company, Limited, of 17, Victoria Street, London, S.W.1. During 1925 this company installed or received orders for 45 Ajax-Northrup high frequency furnaces, 6 Ajax-Wyatt furnaces, 14 electric resistance furnaces and three Héroult arc furnaces.

To Cut Soft Rubber.—Difficulty is often experienced in cutting soft rubber smoothly, even when a very sharp knife is used. This, however, may be accomplished quite easily if the knife is dipped frequently (whilst cutting) in tepid water.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Influence of Special Elements on Grey Cast Iron.

To the Editor of THE FOUNDRY TRADES' JOURNAL.

SIR,—Will you kindly allow me to correct a possible wrong impression that may be conveyed by your report of my discussion on the above paper found on page 556 of your issue of December 30, 1925?

With regard to the influence of manganese, I drew attention to the fact that manganese added to a cast-iron mixture in, say, the crucible by means of ferro-manganese, had a hardening effect, and perhaps slightly closened the grain of the cold metal. If, however, the manganese required were obtained through increasing its percentage on the blast-furnace burden, the general effect would be to open the fracture of the pig-iron produced.

No mention of this latter resulting in "higher carbon" was made by me, but what I did indicate was that because of this open fracture of pig-iron, even with a slightly higher manganese the combined carbon would be lower than with the same percentage of manganese in a foundry mixture of cast iron, where the manganese had been added either in the ladle or the cupola.

Next with regard to practical work. What I stated was that many of the tables shown by the author were of laboratory experiments, and that the author's researches had been on a practical scale, which showed their greater value and explained some of the differences between the author's results and those obtained by other workers quoted by him.

The author's reported reply confirms his agreement with me during the course of my remarks, and it is only due to Mr. Donaldson that these should be made quite clear.—Yours, etc.,

E. ADAMSON.

18, York Street, Sheffield.
January 2.

An Omission.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your leading article of December 31 covering a retrospective review of 1925 you outline the commercial position of several branches of the foundry industry. I regret you have completely ignored the printing engineering trade. This branch of the industry is, and has been for the past three or four years, one of the busiest sections of the trade.

With short intervals I have been a reader of THE FOUNDRY TRADE JOURNAL for over ten years, and I am surprised and not a little disgusted to find that this prosperous section of the engineering industry is deemed by you to be so insignificant as to be unworthy of mention. I think it is a little unfair to the people who take an interest in the trade and the JOURNAL to be so ignored. Undoubtedly this class of foundry work requires the highest scientific, technical and practical knowledge attainable for its success.—Yours, etc.,

PRACTICAL MOULDER.

Otley.

[We sincerely apologise to "Practical Moulder," and we would appreciate from him or any other foundryman annual or semi-annual reports as to the commercial conditions operating in their respective branches of the industry.—EDITOR.]

SIR ROBERT A. HADFIELD, BART., F.R.S., has been the recipient of the decoration of the Cross of the Officier of the French Legion d'Honneur in recognition of his chemical and metallurgical researches.

MR. F. A. MELMOTH, who for many years has been foundry manager to Lake & Elliot, of Braintree, has been appointed foundry manager to Thos. Firth & Sons, Limited, Norfolk Works, Sheffield.

WE REGRET to learn that Mr. J. E. Fletcher, the consultant to British Cast-Iron Research Association, has recently undergone a surgical operation. Whilst he is making satisfactory progress, it is unlikely that he will be able to give any attention to business matters for some time to come.

Commercial Aluminium Alloys from the Users' Point of View.

The annual joint meeting of the London Branch of the Institute of British Foundrymen and the London Local Section of the Institute of Metals took place in December. Dr. J. L. Haughton presided, and a lecture on the above subject was delivered by Mr. J. B. Hoblyn. F.I.C. (of Vauxhall Motors, Ltd.), one of the most entertaining lecturers it has ever been the pleasure of the members to listen to.

MR. HOBLYN, in his opening remarks, said he felt it was rather cheeky to address such a meeting on the subject of "commercial" alloys when he remembered the fundamental work which had been done by members of the bodies represented. At the same time, the metals which they produced had to be used commercially. On the one hand, there was the research worker, who must have the finest products, irrespective of cost, who was continually discovering new facts and producing new and improved materials. On the other hand, there was the practical man who attempted, by reason of his faith in the scientific man, to use the materials which the latter produced, and who, when he attempted to use them and failed, received all the kicks. Between the scientific worker and the user there was the man who tried to emulate the scientific worker, and to produce the alloys, but he had to produce them commercially, and was governed by financial considerations. The question was, how was the work of the scientific investigator utilised by the commercial man—the founder—so that the user could have faith that the material would stand the real test in practice—the test of time? In connection with light aluminium alloys he (Mr. Hoblyn) had done his best to utilise the results obtained by Dr. Rosenhain and his collaborators, and the purpose of his lecture was to see how far the results obtained experimentally from castings made under favourable conditions were reproduced in practice.

Steps for Practical Application of Research Results.

In the first place, in attempting to use light aluminium alloys, one had to convert the engineer, who rightly had to play for safety. The metallurgist would point out to him that if he wanted a high power-to-weight ratio in an automobile he should seriously consider the use of the light alloys of aluminium, because, in getting steel down to its limit in scantlings, he might fail to get the rigidity he would get in the lighter alloys. Then he would ask about the modulus of elasticity of aluminium alloys, and particularly aluminium castings, and would say that he could not get the stiffness he required with them. The metallurgist would then point to "Y" alloy, which was a good sound alloy in the heat-treated condition, giving an elastic limit of approximately 7 tons per sq. in. and a reasonable fatigue range. The metallurgist would further point out to the engineer that if, in an automobile, he could save one unit in unsprung weight, that was equivalent in tyre wear, petrol consumption, etc., to about 10 units in sprung weight. Also, in reciprocating parts, the lightness of the aluminium alloys was a matter which demanded serious attention. Again, big-end failures in the past had been due frequently to the heat produced, but the use of aluminium would obviate a good deal of this trouble, because it was a superior conductor of heat.

The Foundrymen's Part.

When the engineer had been convinced, however, the founder must be approached. When the question of the use of these aluminium alloys for stressed parts came along, about five or six years ago, the founders had not the plant with which to turn out heat-treated castings, and did not show much enthusiasm in embarking upon the manufacture of heat-treated "Y" alloy on a commercial scale. To-day, however, the founder was in a better position. He was usually reasonable, but if anything went wrong, particularly when there were flaws manifest on the castings externally, he blamed the designer. He should blame the designer, however, before he made the castings. Mr. Hoblyn, therefore, urged upon founders that in future, if they were given designs which they considered to be wrong, they should tell the designers so.

Faulty Inspection.

In a further criticism of the founders, Mr. Hoblyn said there were occasions when a fairly large number of castings which should have been rejected by the foundry view room were sent on in the hope that the user might accept them. When they were returned, the founder would say: "How these got through the view room I don't know"; but, said Mr. Hoblyn, he did know all the time. Such experiences were extremely galling to the user.

Internal Blowholes.

Another consideration which presented difficulties from the point of view of the founder was the presence of blowholes inside castings, and which were not manifest externally. Such defects are accompanied by a large waste of money on machining, standing charges, etc. In this connection he mentioned an occasion on which back axle casings of aluminium contained internal blowholes, which were not revealed until the machining operations were completed. The founder could not detect those blowholes in the ordinary way, but he could if he used X-ray apparatus. However, as one founder had said, if X-ray apparatus were used all the castings would be sent back to the foundry from the view room.

Back Axle Casings in 2L5 Alloy.

Mr. Hoblyn then exhibited a number of lantern slides to illustrate the purposes for which he had used light aluminium alloys. The first showed a complete back axle casing with the two halves bolted together, and a torque tube was bolted on to the casing with eight nickel-chrome heat-treated bolts. In the early stages of the development of the Vauxhall 14-h.p. car, the engineers had decided to risk experimentally a back axle and torque tube casting in aluminium. It was decided, after consultation with the founders, to have casings made of the ordinary L5 (now called 2L5) alloy, and casings and torque tubes were assembled and run on two cars. The casings were subjected to continuous tests under severe conditions, the cars, immediately on their return from one journey, being sent off again with fresh drivers. The drivers were told to look for potholes like waste-paper baskets, and to do their best to break the back axle casings, but, however they tried to do that, the casings stood very well. After each car had covered about 25,000 miles, it was felt that there was something in the proposition. They were tried in production, and the casings, on the whole, had behaved remarkably well. The rejects, he should say, had been very small, which could not be said of many other castings the Company had had. This particular job had been handsomely performed, and the Company were grateful to the founders for having done their job so well. A slide of the castings in section was shown, to illustrate that there was nothing difficult about them from the founder's point of view, with the probable exception of the end pieces, there being a little change of section there which might produce difficulties. On the whole, however, there had been no great difficulty in producing them. Out of about 3,000 cars, he did not think there had been one in which the casing had failed by legitimate means. There had been cases of skids, of course, when a back axle casing had hit a telegraph pole or some such obstruction, and, unfortunately, in such an event, an aluminium casing would not stand anything like so good a chance as a steel or wrought aluminium alloy casing.

Torque Tube Failures.

There had been a number of failures of torque tubes, though the majority of the tubes had behaved well. He exhibited a slide to show that there was a possible weakness in the tube radius being too strict at the flange, and some of the torque tubes failed at that point. When the matter of failure was put to the founders they pointed out this defect, which was even more pronounced after machining. Accordingly, more radius was allowed, but still the castings failed. What had been puzzling to him was that the founders could make a fair percentage of the castings which would stand well, but could not make them all to stand. They had stated that their foundry practice was everything they could make it, but the fact remained that some of the castings failed and some did not. He believed that out of the first 1,000 about 20 broke, which was a very serious matter, and on looking into it one or two important facts came to light. The castings in the machined condition were viewed very closely indeed by highly skilled men with very fine magnifying glasses, and he did not believe that any one of the castings had a crack in it when assembled, but one or two had broken on test. In those cases he had found from the fracture that the preliminary coating of a black leadless paint had soaked into cracks around the flange. By no means whatever could the castings have been stressed in any way from the time they left the view room until they were assembled. This experience seemed to show, therefore, that the L5 alloy, on being kept, developed something akin to season cracking. Because of further trouble they had decided to stiffen up the part around the flange, because of the low ductility of L5 alloy (4 or 5 per cent. elongation on chilled test pieces). They began by putting bosses on the flange, and subsequently had decided to rib along the casting in order to give it greater strength.

Aluminium-Silicon Alloys.

Just at that time, however, the founders informed them that they had obtained remarkably good results with a *modified* silicon-aluminium alloy. Some torque tube casings of this material were accordingly sent, and he (Mr. Hoblyn) had cut them up and taken test pieces. He had submitted them to every test he could think of, short of fatigue tests (upon which he had subsequently found this alloy was not strong), and on the results decided to try the material. A fair amount of success was experienced, but there were some breakages, and these revealed the fact that the castings had been poured in such a way that the part around the flange had had sufficient time to go back from the *modified* condition to the normal one; it had reverted during the casting process. He and the founder had felt rather sore about that, because they had felt that with a little more thought the castings might have been poured in such a way that the most important part was not in the weakest condition. As a result the Company had had to stop making torque tube casings in aluminium and go back to steel. When one was fighting hard for the utilisation of these light alloys, and when one experienced failures which one thought could be overcome by the correlation of design with manufacture, it was very hard indeed to feel that one was retrogressing and going back to steel. Not material, but rather design and manufacture were in error. The light alloys were still used for back axle casings, however, and had given remarkably good results. One difficulty was that, having low elastic limits, there was a tendency for slight plastic flow, and there had been a little trouble which seemed to show that there might be some slight sag of the casing as a whole, owing to the alloy being in a constant state of slight plastic deformation.

Another slide of a torque tube casing was shown to illustrate that, as a casting, there was nothing whatever of which a founder might complain.

Hub Castings.

Discussing a photograph of a hub, Mr. Hoblyn said that hubs had been tested on cars on French and Belgian roads, in the war-time condition, under very severe conditions, and had given no trouble. In Y alloy, in L5, and in the *modified* aluminium-silicon alloy, success had attended every effort. The castings, on the whole, had been very good, and there had been few rejects.

Cylinder Heads.

A slide of an engine cylinder head was then shown. These heads had given serious trouble. They were always porous and the Company could not get them to stand water pressure of 20 lbs., though they were required to withstand 45 to 50 lbs. Naturally, whenever a cylinder head of that kind was porous, it was fatal. The Company's experience had led them to wonder whether an aluminium cylinder head was quite the right thing, because on a slow-running engine the high heat conductivity of the head helped to starve the cylinder of some of the heat it required, so that, instead of smooth running, there was an intermittent jogging. In work in this connection, the Vauxhall Company had used L8, because it was the best from the point of view of withstanding temperature effects, but there had been difficulty with that. They had then used a modified aluminium-silicon alloy, and had since had that changed to a copper-silicon alloy, but in no case had the castings been produced as free from porosity as they would like them to be.

Aluminium Pistons.

The Company were one of the first firms to use aluminium pistons, and had used them for years with great success. It was very rarely that they had a breakage of an aluminium piston due to loss of strength. One of the bugbears in the use of the aluminium piston in the past had been the lapping effect it exerted on the walls of the cast-iron cylinder, resulting in wear of the latter. There might be four reasons for that. One might say that L8—the usual 88: 12 alloy—was relatively soft. Under 1,000 kgs., it gave a Brinell hardness between 70 and 90 for a good casting. Many argued that road dirt became embedded in the alloy and acted as an abrasive. Others said that the difficulty was the thin section of the piston ring, and still others that it was the hard $CuAl_2$ eutectic which helped to score the cylinder walls. The first and the third causes could be eliminated by using a much harder alloy, and the substitution of thicker and broader piston rings was a straightforward job. If one wanted a hard alloy for piston work, there was nothing to-day to touch the heat-treated "Y" alloy. He had seen "Y" alloy pistons used for thousands of miles without the slightest cylinder wear, and that, he believed, was due to the fact that, to begin with, it was so hard, and, secondly, that the $CuAl_2$ eutectic was suppressed. The Company had obtained the "Y" alloy piston with a Brinell hardness under 1,000 kg. up to 138, with heat-treatment for 6 hours at 530 deg. C., and heating in oil at about 200 deg. C. for 10 hours. That was very expensive, he agreed, but a hardness was obtained which was out of comparison with that of any other cast-aluminium alloy on the market, and success had attended its use.

Mr. Hoblyn said he would be glad if the speakers in the subsequent discussion would give their views as to the future for aluminium castings for stressed parts in motor cars. The parts which he had referred to were parts which were reasonably highly stressed. The aluminium casting had been used for years for small parts which were not highly stressed, but for those which were, the aluminium casting in the un-heat-treated condition might be getting towards its last days. Already the writing was on the wall. Certain firms had said they wanted stiffer castings, and hence some manufacturers had gone back from the aluminium crankcase to the cast-iron crankcase. The founders would be forced to work really hard in the future, and would have to put in heat-treating plant. It was only a few years ago that many Sheffield firms had rejected the idea of heat-treating steel. The leading firms were, of course, fully aware of its great value. The lamp of heat-treatment, kindled by such men as Sorby, Le Chatelier, Osmond, and others, had been honourably kept aflame in this country, particularly in regard to aluminium

alloys, by the work of Rosenhain and his collaborators; but if the flame were only going to flicker among the founders, they would probably find in the near future that the ordinary un-heat-treated aluminium casting would retrogress and cast iron would take its place. There was already, as he had said, a beginning in that direction. Frequently one heard engineers saying that, but for aluminium, they would be all right, and that for castings they wanted grey or malleable cast iron. He believed the cast-iron founders could make really good cast iron now. The Cast Iron Research Association and the Non-Ferrous Metals Research Association were progressing, but he felt sure that Dr. Hutton would heartily agree that whatever could be done to strengthen the light aluminium casting and the light aluminium wrought alloys, as steel had been strengthened, should be done. If manufacturers could only afford duralumin, with its reasonably good elastic limit, or wrought "Y" alloy, they would be satisfied, but it was a question of cost, and if they could not use the wrought alloy they had to use the casting. If England were to produce motor-cars characteristic of the British race the manufacturers must have individuality and a consolidation of interests. American cars, although remarkably good from the performance point of view, came on to the market resembling each other like peas. From the national point of view it was necessary to get that desire for individuality engrained in the minds of the producers in this country.

Engine suspension brackets made first in L5, then in "Y," then in the aluminium-silicon alloy, were shown by Mr. Hoblyn to have stood well.

A number of slides were then shown illustrating castings which were badly affected by blowholes. Mr. Hoblyn emphasised the point that many of these were internal and could not be discovered by ordinary means of inspection, so that X-ray inspection was desirable before machining operations were commenced.

Wrought Aluminium Alloys.

The Vauxhall Company's experience with wrought aluminium alloys was then discussed. The company had tried to use them, and between 1919 and 1922 they had used a few, but could not use many because of the price and because of the difficulty of getting the alloys they wanted. What they had used, however, had behaved splendidly.

A slide showed a number of parts which had been made in "Y" alloy. In the early days, when the National Physical Laboratory had published some of its researches on "Y" alloy, they had introduced the company to the Royal Airship Works at Cardington, who supplied them with a considerable amount of wrought "Y" alloy in the heat-treated condition. It was made into levers, connecting rods, etc., being substituted for steel, and in every case in which the substitution was made success had rewarded the company's efforts, Among the parts shown on the screen were a connecting rod, a piston and various other parts in forged "Y" alloy, all for a special racing car, and the alloy had behaved remarkably well. A racing car which would lap Brooklands at over 100 miles per hour was fitted with "Y" alloy connecting rods. The engine developed 120 h.p. on the bench, it was well used, and the rods stood. What the future of the aluminium connecting rod was going to be, however, was difficult to forecast, for the work of Jasper and Moore in America showed that the so-called "safe range of stress" for duralumin was not a safe one. In the past it had been accepted, generally speaking, that if a steel would stand up to 100 million stress reversals of a particular magnitude, that steel would stand for ever, and experience seemed to have proved that to be so up to the present. Jasper and Moore, however, had continued the stressing on duralumin, and had found that at about 135 million stress reversals at the range of stress that was safe at 100 million it broke down. Subsequent work might, of course, contradict this. At any rate, there was no doubt that if "Y" alloy would stand 135 million stress reversals at about plus or minus 8 tons per square inch, the designer had plenty to play with, and could easily design rods which were much lighter than steel with a reasonable factor of safety. Several stampings had been made, and subsequently heat-treated, and had stood remarkably well.

Another slide of a connecting rod in "Y" alloy, used on a racing car, was shown. Rods were made from forgings which were heat-treated and which required a considerable amount of machining. The company had had a few stamped out, but owing to the fact that quantities of "Y" alloy for stamping could not be obtained at the time, the company used duralumin. Thousands of connecting rods of that material had been used in cars with great success, and there had, so far as he knew, been no cases of failure. The mileages of some of these cars must now be close on 100,000.

"Y" Alloys as a Bearing Metal.

One very important feature about "Y" alloy, one which was difficult to get the engineer to appreciate, was its very satisfactory properties as a bearing alloy. He had had the end of a connecting rod running directly on a 0.35 per cent. carbon steel crankshaft, but the wear was negligible, being nothing more than it would have been with a white metal bush there. The saving of the white metal bush would nullify a considerable amount of expense and labour. There would be two good wearing surfaces together, but the engineer did not like to risk it. He believed that one motor-car firm in America had experienced it. They had run duralumin rods directly on a case-hardened shaft. On experimental cars it had been successful, but not when the cars were made in production. When the scleroscopic hardness of the shaft was over 70 the wear was negligible, but when it was under 70 it was noticeable. It should not be difficult, however, to get case-hardened webs regularly with a hardness of 80; generally it was about 85. He himself had not tried duralumin rods for this particular purpose, but probably they would stand up equally as well as the "Y" alloy. If the founders could get a good die-cast "Y" alloy connecting rod, heat-treated, for some of the cheaper cars, their foundries would earn big money, and it was a problem worthy of consideration. If they were heat-treated correctly, and die-cast correctly, very good results should be obtained. He urged the founders not merely to make them, but to give some away to motor-car manufacturers as Christmas boxes, and to see that the rods were put into the engines.

Aluminium Front Axles.

A duralumin front axle fitted to a racing car, and which was still standing after a reasonable amount of service, was then illustrated. Powerful front wheel brakes were used on the car. A man might say that he would not like to travel at 100 miles per hour on that axle, but if it were heat-treated it should be quite good, except for the question of its life under fatigue. Until that matter was settled, therefore, one must not fit a "Y" alloy or duralumin front axle to any car but one's own.

Another instance of the applications of duralumin was that of a frame, but unfortunately that frame had not yet been used. There was a duralumin sub-frame, on which a very heavy engine was assembled in a racing car, and that had stood remarkably well.

In conclusion, Mr. Hoblyn said he really did believe that there was a future for heat-treated aluminium alloys in automobile construction. In stressed parts the castings, if heat-treated, had a very extensive field, as also had the wrought alloys, if only the founders would get them made and acquaint people of what they were doing.

Safeguarding of Industries.

Enamelled Hollow-ware Committee.

The public meetings for the taking of evidence by the Safeguarding Committee on Enamelled Hollow-ware, previously announced for December 16, 17 and 18, and subsequently postponed, was held yesterday and this morning and will be reopened on Wednesday, January 13, at 10.30 a.m., in Room 456, 6, Richmond Terrace, Whitehall, S.W.1.

The Foundry of Henry Ford & Son, Ltd.

Intensive Production Methods at the Cork Factory.

[We are indebted to the courtesy of the Editor of the "Automobile Engineer" for permission to reproduce this article.]

Although relatively a very small part of the Ford organisation, the Irish Free State plant provides abundant evidences of Ford principles and manufacturing policy. The Cork works is operated under the name of Henry Ford & Son, Limited, and in addition to supplying the requirements of the Irish Free State in cars and tractors, it provides all the engines and rear axle assemblies required by the Trafford Park works. Henry Ford & Son, Limited, is a separate and distinct organisation from the Ford Motor Company (England), Limited.

The question has frequently been raised amongst automobile engineers as to why Cork was selected as a site for the factory. After thorough investigation, however, it is evident that it possesses many advantages which have been utilised to the full in providing economic transport of raw material and finished parts. We are also informed that Mr. Ford's ancestors came from the district within a few miles of the factory, and this may have had some bearing on the choice of the location.

A view of the factory taken from the opposite bank of the River Lee is shown in Fig. 1, and it will be seen that very fine dock accommodation is provided. Moreover, by means of a 5-ton transporter, which runs along the entire length of the quay in front of the factory, the handling of goods is reduced to an absolute minimum. For example, the raw materials for the foundry are unloaded from the boat by means of the transporter, which deposits them in the place where they are required. Coke is dropped through trap doors in the roof of the factory on to the charging gallery, whilst a well in the charging gallery itself allows moulding sand to be dropped through to the floor below on to the sand mixing machine.

The factory itself is of steel and concrete construction, and is built on the well-known one-storey plan that characterises all new Ford plants. It provides a fine example of modern factory architecture, both with regard to general layout and considerations of lighting, heating, and ventilation.

Actually the covered area is quite small, being about six acres, but the works is located on a site covering nearly 130 acres, so that ample space is available for extensions if necessary. Another significant point in connection with the works is the relationship between the area of the foundry and other departments. The foundry itself covers nearly 94,000 sq. ft., in addition to which the charging floor area is upwards of 16,000 sq. ft., whilst the machine shop covers an area of 116,000 sq. ft.

In view of the size of the factory the output is remarkable, the average production from the foundry being approximately 60 tons of iron castings per day, depending, of course, upon the nature of the work. On heavy castings it is not uncommon for the daily output to reach 100 tons. For instance, the equipment is arranged for casting 500 cylinder blocks in eight hours. From the machine shop the output of those parts allocated to the Cork factory is roughly 2,000 sets per week, this including all the components of the engine and rear axle units.

Referring to Fig. 1, the foundry is situated on the left in the illustration, the storage yard for pig-iron and scrap being on the extreme left, while the charging gallery occupies the entire front of the foundry. Four Whiting cupolas, two 72 in., one 63 in., and one 36 in., together with a 1-ton revolving brass furnace and two Morgan tilting crucible furnaces, give a total melting capacity of 150 tons per day.

The foundry is remarkable for the fact that it is run almost entirely on the conveyor system, whilst all transportation is effected by overhead runways. Trucks and wheelbarrows have been practically eliminated. Briefly, the general procedure is as follows:—Moulding sand, after mixing, is raised by an elevator to an overhead belt conveyor, which fills a number of hoppers situated above the moulding machines, so that the boxes can be filled in the minimum of time. The moulds are then transferred to hangers, which are suspended from an overhead conveyor, and at the point nearest the cupolas the castings are poured. At the opposite end, after the metal has cooled sufficiently, the boxes are moved from the conveyor to a grating, where the castings are knocked out, the sand falling through the grating on to a conveyor, which returns it to the mixing plant. The foundry is, in fact, run on thoroughly American lines, the conveyors being duplicates of those installed at the Ford Motor Company Plant, River Rouge, Dearborn, Michigan.

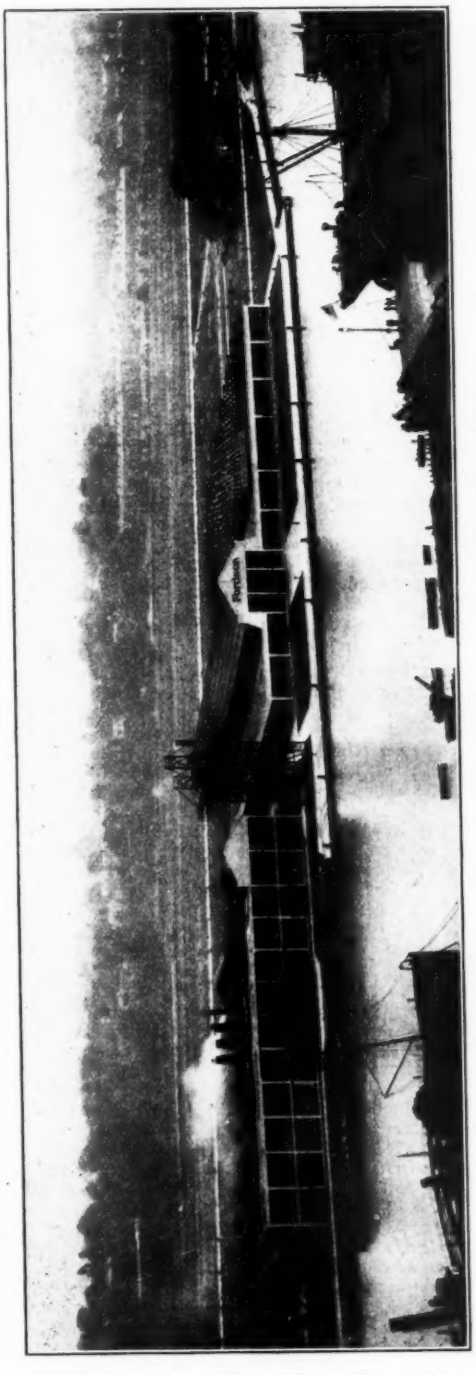

FIG. 1.—A VIEW OF THE WORKS FROM THE OPPOSITE RIVER BANK.

In handling heavy castings, such as cylinder blocks, a drag type of conveyor as shown in Fig. 2 is utilised. It may be observed that three con-

veyors are arranged parallel to one another, the two outer tracks being adjacent to the moulding machines, so that the moulds can be placed on the line with the minimum of trouble. These conveyors carry the moulds to the far end of the foundry, where the castings are poured, after which they return along the central conveyor, which moves at twice the speed of the two outer lines.

The length of the track is 288 ft. and the speed of the conveyor is 10 ft. per minute, so that by the time the castings reach the other end of the central line they have cooled sufficiently to be knocked out on the gratings shown in the fore ground in Fig. 2. It may also be seen that a hood is in course of construction over the central track so that by coupling up to an exhaust fan all smoke and fumes from the moulds after pouring may be carried away.

The overhead gear in this section of the plant comprises two Link belt conveyors with distributing gear for supplying the two rows of sand hoppers. Provision is made for regulating the supply of sand to any particular hopper by means of sliding shutters, so that the hoppers nearest the elevator are not filled to the exclusion of those further away. A 2-ton monorail runs between the cupolas and the section of the conveyor at which the castings are poured.

In handling smaller castings, the same general procedure is adopted, except that, in place of the drag type of conveyor, hangers are employed to carry the moulds. A group of moulding machines is shown in Fig. 3, in which the arrangement of the sand hoppers may also be clearly seen. The hinged doors which close the mouth of each hopper are so arranged that they are normally held together by gravity, whilst they are also geared one to the other, so that when the handle shown is pulled downwards, the shutters open simultaneously. Filling the boxes in this way is quite a simple operation, and the moulds can quickly be rammed by hand, after which they are squeezed before being lifted off and placed on the conveyor.

FIG. 2.—THE CYLINDER BLOCK CONVEYOR IN THE FOUNDRY.

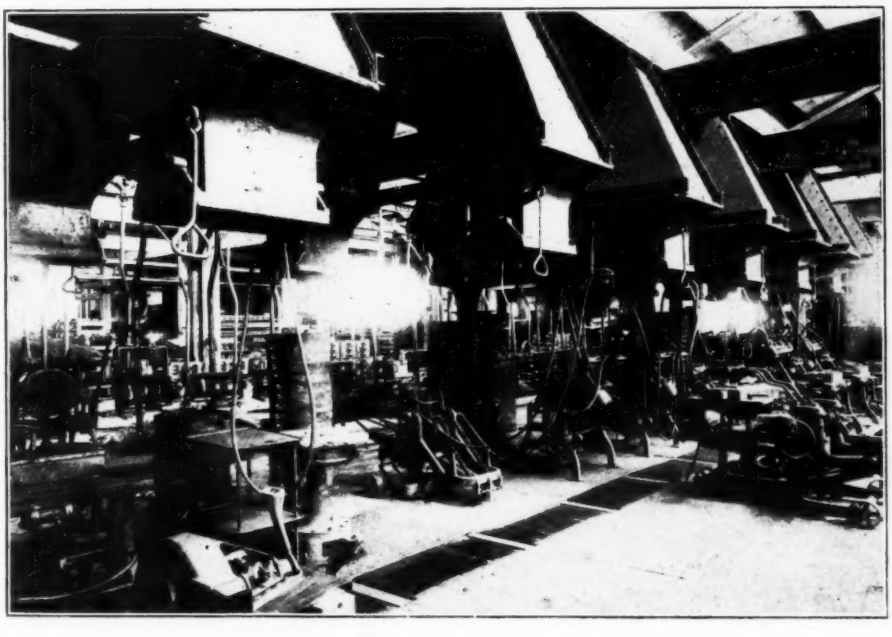

FIG. 3.—A GROUP OF MOULDING MACHINES AND SAND HOPPERS.

A view of the reel type of conveyor, or "merry-go-round," as it is called, is shown in Fig. 4, from which it may be seen that it consists essentially of a number of hangers suspended from an endless monorail. The hangers are coupled together by links, so as to form an endless chain, which is driven at a speed of 15 ft. per minute by means of plates projecting from the periphery of a large wheel at one end, this in turn being driven through the medium of reduction gear. Two of these conveyors are employed, one on each side of a central battery of moulding machines. Each conveyor carries forty-eight hangers, and the entire equipment occupies a floor space of only 82 ft. by 51 ft. The front end of each conveyor is adjacent to the monorail previously mentioned, which runs in front of the cupolas.

Equally interesting methods are adopted in core making. This also has been reduced to a continuous process, except, of course, that a considerable amount of hand work is unavoidable. The operators, however, have acquired remarkable dexterity, so that a comparatively small number of men are able to maintain a continuous supply.

Before baking, cores are sprayed with graphite mixture, and they are then placed on trays in the continuous core oven shown in Fig. 5. The revolving table employed for spraying the cores may be seen on the right in this illustration. It is made in the form of a cage with five compartments, in each of which is a separate revolving table, on which the core is placed, so that it may be rotated during the spraying on of the mixture.

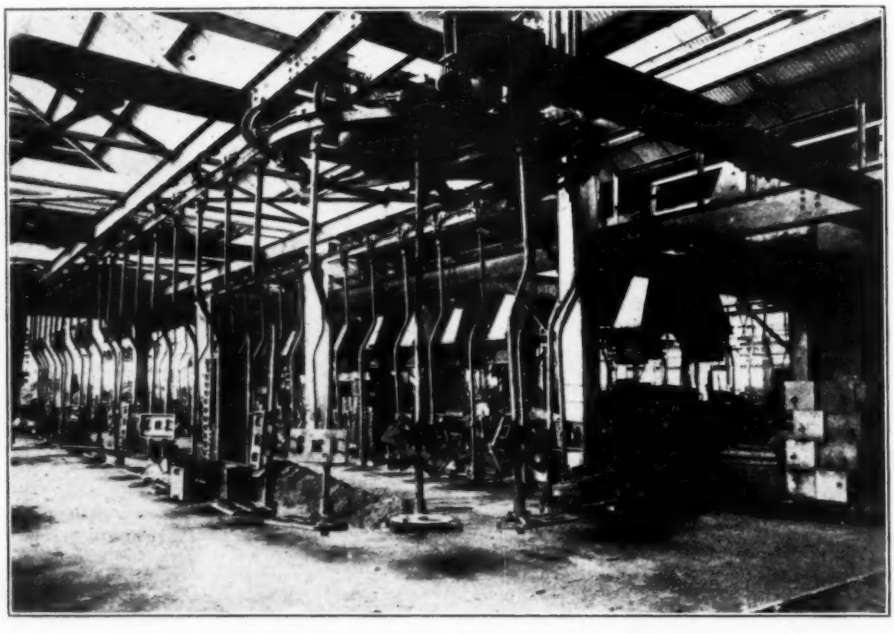

FIG. 4.—THE "MERRY-GO-ROUND" MOULD CONVEYOR.

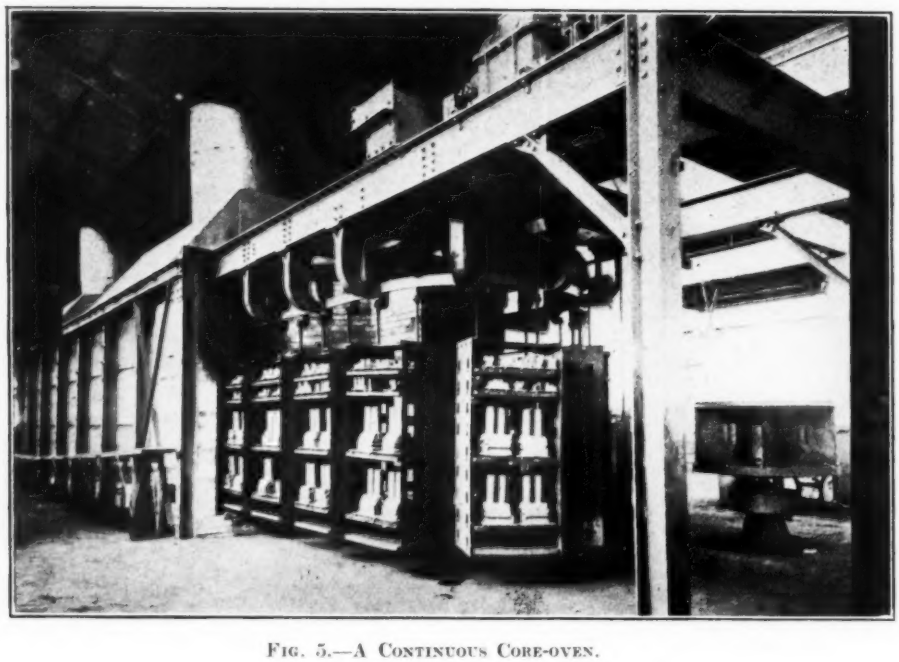

FIG. 5.—A CONTINUOUS CORE-OVEN.

The core oven itself is an extremely interesting structure, occupying a space of 74 ft. by 18 ft. It consists of a number of steel cages suspended from a monorail and driven in a similar manner to the reel type of conveyor, so that the cages pass through the furnace at a speed which ensures that the cores emerge uniformly baked to the correct degree. Actually the time cycle of the core oven can be varied from 3 to 5 minutes as required, whilst its capacity will be evident from

the illustration. The furnace is fired by means of crude oil.

Another type of core oven is also employed for handling a variety of smaller cores on a continuous basis. This consists of a revolving cage built in the wall of a furnace, so that one portion remains within the furnace for drying cores, whilst the other half is in the loading position. The furnace is regulated so that the time taken for drying the cores is approximately equal to the loading and unloading time.

From the output figures given above, it might be assumed that a large number of men are employed in the foundry. Actually, the total number is 650. The output is only obtained by the men keeping time with the mechanical side of the organisation, *i.e.*, the conveyor system, etc. To do this means continuous application, and there can be no doubt that, compared with average foundrymen, the Ford employees certainly do work at an exceptional speed, despite the fact that none of them is on piecework. The explanation is probably to be found in the pay envelope.

In the same building as the foundry is the fettling, rumbling, and sandblast department, whilst an interesting section of the plant is also devoted to the production of magnets for the special form of magnets which is used on the Ford car. A view of this plant is shown in Fig. 6, although this illustration does not give a clear view of the machines employed for forming the magnets from bar stock. For this purpose the stock is first heated in a tubular type of furnace, from which it is transferred to a machine in the immediate vicinity of the furnace for cutting the bars to length and forming the vee-shaped blanks. This machine is a special type of horizontal press or bulldozer, having pivoted die blocks which close around the poles of the magnets as the ram advances.

Before being magnetised the blanks are hardened and tempered in a special form of heat treatment furnace, which works on a continuous basis so as to obtain uniform results. The furnace is shown in the illustration at the rear of the quenching tank, and it may be seen that it is inclined so that the blanks may be loaded on to an endless conveyor at the upper end of the furnace. The speed is regulated so that the parts take a uniform time to pass through the furnace, and emerge at the lower end, whence they fall into the quenching tank. The furnace is oil-fired and so arranged that the highest temperature is at the lower end, the temperature at this point being the proper heat for quenching. A basket in the quenching tank collects the blanks and enables them to be transferred in bulk to a tempering tank for artificial ageing.

A rumbling barrel is then employed for removing the scale prior to magnetising the blanks between the poles of powerful electro-magnets. The magnets are subsequently graded and placed in compartments, as shown, so that sets of uniform magnets may be arranged in trays, these being shown in the foreground in the illustration. A special form of magnetometer of the type used at the works of the Ford Motor Company, Highland Park, Detroit, is used for testing each magnet separately, although this test is not carried out until 24 hours after magnetising, so that it provides an indication of the retentive properties of the steel. The magnetometer itself is similar to an ordinary switchboard instrument, and the test occupies only a few seconds. Another point to be noted in connection with the equipment in this section is the arrangement of the various units in line, so that the processes can be carried out continuously with the minimum of handling.

Between the foundry and the machine shops and the assembly departments are the tinsmith shop, the millwright section, and the smithy, as well as a separate heat-treating department.

The drawing-office and laboratory are also situated conveniently to the machining section, and in the immediate vicinity of the heat treatment plant. In the laboratory careful control is maintained over raw materials, whilst the metallurgical staff exercise close supervision over every charge of metal melted in the foundry. Three grades of cast-iron have been adopted as standard, and the composition of these is kept uniform within very close limits. This is an important feature, in view of the high speeds and heavy feeds which are employed in machining the castings, since a batch of hard castings might easily cause considerable dislocation.

FIG. 6.—THE PLANT FOR MAKING MAGNETS.

EDWARD G. HERBERT, LIMITED, Atlas Works, Chapel Street, Levenshulme, Manchester, have now established a London sales office at 68, Victoria Street, Westminster, S.W.1. Mr. G. W. Risdon will represent the company in the Metropolitan area.

THE WESTERN AUSTRALIAN GOVERNMENT has accepted an English tender for seventy miles of rails, with the option of taking an additional hundred miles at the same price. It is understood that the price was £100 a mile below the Broken Hill Company's tender.

THE PARTNERSHIP heretofore subsisting between Messrs. A. E. A. Davies and P. J. W. Vickery, engineers and tool makers, Queen Street, Castle Street, Bristol, under the style of Ernest Davies, has been dissolved.

The Wrought-Iron Industry, 1925.

An interesting Paper on "The Wrought Iron Industry, 1925," was delivered by MR. S. J. ASTBURY, M.A., Asso.M.Inst.C.E., before a meeting of the Staffordshire Iron and Steel Institute at Dudley on December 16. He said the outputs of finished wrought-iron bars and of puddled bars respectively in Great Britain and France during 1924 and in Belgium during 1923 were as follow:—

	Gt. Britian 1924.	France 1924.	Belgium 1923.
	Tons.	Tons.	Tons.
Finished iron	443,400	39,396	210,020
Puddled bars	305,400	4,664	30,590

The proportion of the total output formed by puddled bars was thus 68.9 per cent. in Great Britain compared with 11.3 per cent. in France and 14.6 in Belgium. It was reasonable to assume that such a large disparity between the proportion of puddled bars in Great Britain and the corresponding figures in France and Belgium should indicate some radical difference in practice. The British wrought-iron industry was fully alive to that fact. Consumers of wrought iron, generally speaking, were not.

In a Paper given four years ago before that Institute by Mr. L. G. Harris, he concluded that the Belgium iron trade had an advantage over the British iron trade of, roughly, 40 per cent. lower net cost of the piles charged into a mill furnace. This was almost entirely due to the Belgian practice of making a pile of the faggoted box-pile type, with puddled bars at the top and bottom and a mixture of wrought iron and steel scrap inside. About 80 per cent. of the pile was mixed scrap and 20 per cent. puddled bars. The puddled bars themselves could only be termed as semi-puddled, owing to the practice of throwing miscellaneous scrap and swarf into the furnace at the balling-up stage. The result of these methods was that the Belgians were able to start with a mill pile at a cost of about £6 13s. per ton, as against our 1921 cost of about £9 18s. Since 1921 the stream of cheap inferior Continental material, which was wrought iron in name only, imported into this country had continued unabated. The following table of tonnage imported was interesting:—

Imports of Wrought Iron into Great Britain.

Year	Belgium	France	Germany	Totals.
	Tons	Tons	Tons	Tons.
1913	98,104	226	47,680	146,010
1923	120,898	1,671	4,832	127,401
1924	205,376	11,163	15,815	232,354

In other words, the tonnage of imported iron in 1924 amounted to more than half the total production of wrought iron in Great Britain in that year. In 1913 the corresponding figure of imported iron was only 15.4 per cent. of the finished iron consumption in that year of 946,400 tons. It was that Belgium and France were supplying a supplementary quality of iron which the natural resources or manufacturing methods of this country would not enable us to produce—such as was the case with Swedish charcoal bars and sections. Indeed, the importation of Swedish bars had considerably fallen off, and in 1924 was only 12,148 tons, as against 52,188 tons in 1913—roughly, 23 per cent.

Puddled iron did not enter into competition with charcoal iron. Both had their own market and uses, and a parallel between Belgian and Swedish imports—as the author had met with in Continental propaganda circulars—was without meaning. On the other hand, it was certain that the bulk of the Belgian and French iron which had been imported had been used up for requirements, which in 1913 would have been met by British puddled iron.

Economic Effects.

British consumption, continued the author, was, in fact, rapidly putting the Belgian iron industry on its feet again, and helping it back to the pre-war level of production. In 1913 Great Britain imported 32.2 per cent. of the total Belgian output of finished iron. In 1923 this figure had risen to 57.5 per cent., and on the monthly average of the first nine months of 1924 Great Britain was taking between 80 to 90 per cent. of the Belgian output, which was rapidly approaching its pre-war average of round about 300,000 tons per annum. Meanwhile the British iron industry was suffering a period of unparalleled hardship.

It was worth while considering in detail the full economic effects of this importation of foreign material. Taking 1924 statistics, a total of about 200,000 tons of wrought iron had been imported, which might have been produced in this country. The direct "employment value" of this tonnage was about 6,000 men per annum, without taking into account any of the subsidiary industries affected, such as blast-furnacemen and railway workers. The loss in wages, and, therefore, loss to general trade, might be put at the least £800,000 per annum. In addition, the cost to the nation of these unemployed was not less than £70 per man per annum—a total of £420,000 per annum in unemployment benefit. The average difference in the cost of the imported iron at £8 a ton, and the same tonnage produced in this country at the nut and bolt price of £11 a ton might be put at £600,000. Thus, in the final result, a very small net saving had been effected, while over £1½ million had been spent abroad which might have been spent here, and 6,000 men had been kept in idleness for a year, with an inevitable loss of technical skill and morale.

Probably the most serious of all results was the diminution of potential capacity for future requirements owing to the dismantling of so many works—in which respect that district had suffered more than any other. There were mills in South Staffs. served by gas-fired furnaces which were the equal in point of efficiency to any mill on the Continent.

Mixtures of Steel and Iron.

Continuing, the author pointed out that in 1921 Belgian iron was beginning to displace British wrought-iron bars in the nut and bolt trade. In the intervening four years its use had extended to branches of the engineering trades which would normally employ a much higher class iron. The result had been a series of failures or complaints. In many quarters wrought iron had earned a bad name for itself, entirely owing to ignorance on the part of the user of the character of the material he was dealing with. It had been repeatedly stated that wrought iron was not so good as it was 20 or 30 years ago, and if this statement had reference to the mixture of steel and iron so often marketed as wrought iron there was no denying its truth. If, on the other hand, a comparison was meant between the genuine puddled iron of 1925 and that produced 30 years ago, there was no justification for the assertion. There was no more treacherous and disappointing material, from a metallurgical point of view, than a mixture of iron and steel which was bought as and used in place of genuine wrought iron. The reasons were not far to seek. The welding temperature for iron was some 150 deg. to 200 deg. C. above the welding temperature of steel. In order to compact the pile box it must be heated in the mill furnace to the higher temperature. At this temperature the steel might be burnt and an extremely brittle bar result. That explained why the Belgian bars might give a perfectly good result at one point in their length and at another snap off like glass.

The consumer of cheap inferior iron and steel mixtures imported from abroad, concluded the author, was not only adding his quota to the difficulties with which the iron and steel industries were faced, but also laying up trouble for himself by employing unreliable and dangerous material. The remedy against the danger of the admixture of iron and steel was in the hands of the user himself and his inspecting engineer. He must include in his specification tests for the detection of steel in iron. The two means generally used were chemical analysis and etch tests. Both of them found a place in many American specifications. Comparisons showed that our specifications were infinitely superior to those of the Continent, and there was growing up an increasing appreciation of the qualities of genuine wrought iron. To ensure that he got the benefits of genuine iron he was now refusing to touch any wrought iron product which had not 100 per cent. iron and which had not originated in the puddling furnace.

Foundrymen Visit Birtley Iron Company.

Between 90 and 100 members of the Newcastle Branch of the Institute of British Foundrymen visited the Works of the Birtley Iron Company, Birtley, on December 12, where they spent a very instructive and enjoyable afternoon.

They were received, on behalf of the Company, by Major K. C. Appleyard (General Manager), who, together with Col. Knothe (Assistant General Manager) and Mr. Fairless (Works Manager), escorted the visitors round the Works.

Though this Company was founded about the

FIG. 1.—FRONT VIEW OF CUPOLA MECHANICAL LOADING SKIPS. THE BIRTLEY IRON COMPANY.

year 1820, the works are still being extended and re-organised, under the supervision of Major Appleyard. They now cover an area of 9½ acres, and, as the company owns much land round about, there is considerable room for the further extensions which it is intended to make.

The Pattern Shop.

The pattern shop, which is a large, well-ventilated building, was fully equipped some 6 years ago with the latest electrical machinery, including a Watkin woodworking machine, and it contains every contrivance possible to make pattern-making a healthy occupation, including adequate ventilating and heating arrangements.

The visitors next inspected the department where pit tubs are turned out, the weekly pro-

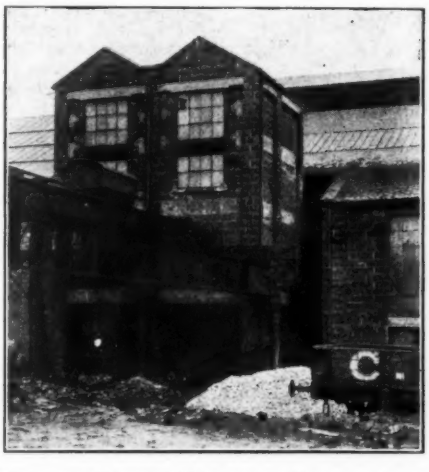

FIG. 2.—CUPOLA HOUSE AND LOADING SKIPS. THE BIRTLEY IRON COMPANY.

duction of these, in good times, being about 120. The tubs are built on the quantity production conveyor system. As each tub passes through the shop it undergoes various operations until, finally, the steel body is finished off at the riveting and trimming platform, meets the wooden sole frame from the joiners' shop, and is sprayed ready for delivery.

In the smiths' shop much interest was shown in an electric butt-welding machine, used for repetition work on these tubs. This machine is capable of welding wrought iron or steel up to 1½ in. square, and when the welds are made, they are finished off with a small air-driven Sullivan hammer. There are also three air hammers, of Massey's type, 3 cwt., 5 cwt., and 7 cwt., respectively, which are used in the production of colliery tubs, a large set of independent-drive punch and shears, power presses and punches and the latest type of plate-working machinery.

The Ironfoundry.

The general foundry, which is approximately 120 yds. long by 50 ft. span, is well-equipped for a wide range of castings up to 25 tons, its weekly output being at present about 70 to 80 tons, and its maximum capacity 120 tons.

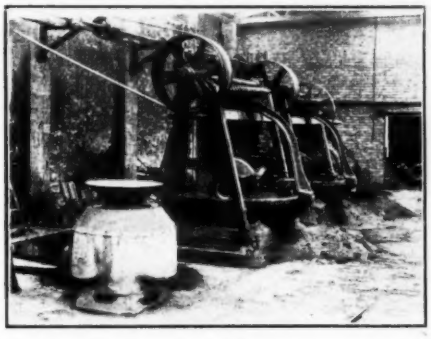

FIG. 3.—THE SAND MIXING SHOP SHOWING TWO MILLS AND DISINTEGRATOR. THE BIRTLEY IRON COMPANY.

Work is carried out in loam, dry sand and green sand castings, the castings made being marine engine, turbine, locomotive, electrical and general engineering work.

The foundry has been reconstructed recently, and two new cupolas installed, the capacity of each being 20 tons per hour. These furnaces are mechanically charged by means of two inclined hoists operating from the bottom. The skips are loaded, weighed, and put on bogies by means of an electric gantry crane which covers the stock-yard of raw materials. Manual labour is thus entirely obviated on the charging platform. Blast is supplied by a direct driven electric centrifugal fan, with a Wilson blast-recorder and damper arrangements to allow of either of the cupolas being worked singly.

The firm has also installed recently three new-type August's muffle stoves, 19 ft., 14 ft., 9 ft. respectively. These stoves, which have proved very efficient and economical, are coke-fired with forced draught and fitted with a pyrometer recorder.

FIG. 4.—THE NEW SMITHS' SHOP. THE BIRTLEY IRON COMPANY.

Sand Mills and Moulding Machines.

The sand storage and mills are in a special annex to the main building, thus obviating any additional transit or handling. The foundry is equipped with a large jolting machine for repetition work, together with two smaller turnover machines for the production of small castings. Transport service is provided by two modern 20-ton electric cranes which have recently been converted from steam.

A large business in gas and water pipes is carried on in the green sand foundry, which is a

separate building. All British and other standards of pipes up to 8 in. dia., are dealt with, and these include spigot and socket; also flanged pipes, standard and special.

It is interesting to note that at the Birtley Iron Company apprentices in their early years receive special tuition from an experienced craftsman, who explains to them in detail the most intricate jobs in progress. Later on they are paired with journeymen moulders and coremakers to the completion of their apprenticeship.

The Machine Shop.

This shop is made up of three bays, each approximately 100 ft. long by 60 ft. span. It has been fitted up recently with the most up-to-date plant, including the latest automatic turning, boring, slotting and planing machines.

Part of its equipment is a "runabout" 20 cwt. electric crane, used for lighter work, and it was noticed that the various bays were carefully marked out for the guidance of this crane, which serves them all. In addition to this the north and south end bays are fitted with 7-ton travelling cranes, which are used for heavier work.

All the details for the pit tubs and units, consisting of axle boxes, axles, etc., which are made on the mass-production system, are machined in multiple in this shop.

Constructional Shop.

The latest addition to the works is a constructional shop, which has materialised only during the last two years. It has already built and erected four complete headgears, however, and a great deal of other work, and it is the intention of the Company to extent this shop greatly for the handling of constructional work in connection with their new coal-cleaning process.

Coal Cleaning Plant.

This novel device, which is an American invention for the cleaning of coal by the dry method, and for which the Birtley Iron Company holds the sole British rights, attracted considerable attention. In demonstrating the workings of this plant, Major Appleyard explained that the whole process of coal cleaning depended upon the virtue of the fact that the specific gravity of shale was about twice that of coal, and could thus be separated from it. In the case of the wet method commonly used, the coal is floated on water, and the shale, being heavier, sinks. In this new method of dry cleaning, the coal is floated on air instead of on water, the process being as follows:—From hoppers the coal travels down on to a slanting table, composed of fine wire gauze and an arrangement of riffles. Air is passed up through the table, and the coal, being light, floats off, leaving behind the shale, which works itself along the riffles to the edge of the table, where it gradually works its way down into a separate hopper. There are two of these machines at the works of the Birtley Iron Company, one of the cleaning tables at the time of the visit working on coal from ½ in. to ¼ in., and the other on ¼ in. to ⅛ in. coal, and by means of these machines it is possible to reduce the ash-content in the coal from about 18 per cent. to 6 per cent. The Company has its own very well-equipped laboratory and technical staff, where the coal is analysed, and which is also equipped for general metallurgical work in connection with the foundries and forges.

All the machinery at the Birtley Iron Company is electrically driven, and the whole of the works is supplied with compressed air by a large Ingersoll compressor, driven by an auto-synchronous motor of 100 h.p.

Vote of Thanks.

Tea was provided for the visitors in the firm's canteen, where, on the motion of MR. M. B. HERBST, the members expressed a hearty vote of thanks to the Company for an interesting afternoon, and for its kind hospitality, and also to Major Appleyard for the instructive descriptions which he had given during their tour of inspection.

MR. W. J. PAULIN seconded the motion, and MAJOR APPLEYARD made a suitable reply.

In the evening, a meeting was held in the Neville Hall, Newcastle-on-Tyne, when a Paper, entitled, "The Training and General Position of the Craftsman," was read by MAJOR APPLEYARD, MR. HERBST (Branch-President) presiding.

Copper Castings.

BY A. R.

The uses of copper are too well known to need enumeration. Apart from its electrical uses, it is sufficient to draw attention to its suitability for resisting corrosion, and the fact that, because of this property, it is extensively used in place of other metals which would corrode rapidly under the same conditions. These frequently include a high degree of temperature, and it is necessary, therefore, for the copper to retain its strength at these increased temperatures. Examples of these conditions are in boilers, and steam pipe and compressed air work. A further recommendation for its use in the last two classes of work is the ease and thoroughness with which a brazed joint can be made between two pieces of copper; the strength of the finished work, if well executed, being often stronger than the metal itself.

The strength of pure copper decreases with a rise in temperature, although the effect can be counteracted to some extent by the addition of small quantities of other metals Where pure copper is required, however, the weakness must be allowed for. Gibson and Chorlton give the ultimate strength at a temperature of 150 deg. C. as 14 tons per sq. in., and at 315 deg. C. as 9 tons per sq. in. The same authorities state that as long as the temperature does not exceed 150 deg. C. a safe working stress of 1½ tons per sq. in. can be relied upon.

There is a very wide range of copper alloys of varying properties suitable for different purposes. Among those alloys, which may almost be termed slightly impure copper, some of the most widely used in commerce are those containing a slight amount of arsenic, from 0.3 to 0.5 per cent., the remaining 99.7 or 99.5 per cent. being copper. The presence of the arsenic hardens the copper and improves its tenacity. It also increases the percentage elongation. A more important effect of the addition is that it improves the strength of the metal at high temperatures, and makes it suitable for use in steam and compressed air plant.

Molten copper readily absorbs certain gases. Among these are some gases given off by the usual furnace fuels, such as carbon monoxide, hydrogen, and sulphur dioxide. When the metal cools the gases which have been dissolved during melting are given off, and this usually results in bad castings. It is necessary, therefore, to keep the gas out of contact with the surface of the metal, and to use non-porous crucibles. Some of the common graphite crucibles are quite porous to furnace gases.

The United States Bureau of Mines makes some special recommendations in connection with melting brass in electric furnaces. Some of these would seem to apply particularly well to melting copper. One is that, by means of an electric furnace, the melting can take place in a neutral or reducing atmosphere. This avoids the risk of contact with the gases given off by coke fires, as also does the fact that ordinary crucibles are not used in this type of furnace.

The effect of oxygen on copper has been investigated by Dr. Hanson at the National Physical Laboratory. The precautions taken during this investigation to control the absorption of gas by the metal are interesting in connection with the absorption of furnace gases mentioned above.

Dr. Hanson tried various ways of melting, and found the most successful to be a graphite crucible lined with clay. An unlined crucible was found to give trouble by reacting with the oxygen absorbed by the copper from the air. Various methods were tried in order to obtain a suitable covering to separate the surface of the molten metal from the air; among these were a covering of broken graphite which, however, was not effective; a covering of borax, which attacked the crucible; and a covering of molten glass, which proved satisfactory. In order to facilitate pouring, this glass was thickened by the addition of sand, so that it could be held back by a rod.

Discussion on Mr. Melmoth's Paper on "Some Metallurgical Points on Electric Steel Castings and Notes on Defects."*

In the absence of the Author, this Paper was read by Mr. G. Batty, Technical Director of the National Steel Foundry (1914), Limited.

The discussion was opened by the CHAIRMAN (Mr. J. Masters), who asked for information as to the effect of the higher casting temperature of basic electric steel. This might be the cause of the additional contraction which was experienced.

MR. BATTY agreed that high-casting temperature was a contributory factor to additional contraction, but the higher casting temperature of basic electric steel, as compared with converter metal, by no means covered the whole difference. It did not seem logical that casting temperature should affect the actual freezing temperature of the metal, but experience appeared to indicate that this was the case.

Contraction was covered by the difference between mould dimensions and the ultimate dimensions of the cold casting. Steel, whether cast into sand moulds or chill moulds, solidified on a system which might be described as a continuously thickening envelope. One must visualise an initial solid envelope formed within a very short space of time after the metal touched the mould. This initial envelope was maintained in tight contact with the faces of the mould for a certain length of time by the ferro-static pressure exerted by the liquid steel within the initial envelope. As the envelope thickened and was able to exert a force greater than the ferrostatic pressure of the liquid interior of the casting, the component began to contract consonantly with decreasing temperature. In the case of both hot-cast and cool-cast metal, the initial envelope is maintained for a certain length of time in contact with the mould, but it is fairly certain that the metal which is cool-cast has a greater rapidity of thickening of the initial envelope than has the hot-cast component. It seems reasonable to assume that hot-cast metal will bake the mould more extensively than will the cool-cast metal, and, therefore, the hot-cast metal should create a greater mould-resistance to contraction. He was speaking of metal cast into green sand moulds, and he thought the members would agree that it was somewhat contradictory that hot-cast metal, having a tendency to increase the resistance offered by the mould to contraction, should actually contract to a greater extent than metal which was cast at a lower temperature, and, therefore, produced a less degree of mould resistance to contraction. It might be that he was attaching undue importance to the baking effect of the metal upon a green sand mould, but, even if the baking effect was non-significant, it must be remembered that the additional contraction experienced with hot-cast metal indicated that a high casting temperature resulted in a higher freezing temperature. Such a point appeared to be incapable of proof, but general observations tended to indicate that the solidification temperature was definitely affected by casting temperature. What they were discussing at the moment was contraction in the solid condition as distinct from the liquid or fluid contraction. The point was proved very definitely by one incident in his experience.

Contraction in Wheel Castings.

Two wheels from the same pattern were cast from one heat of basic electric steel, one being cast whilst the metal was very hot, the other being cast from practically the last metal in the ladle. The moulds were, as nearly as possible, identical in degree of ramming, and they were of practically identical dimensions; yet the hot-cast metal had a contraction appreciably greater than that of the cool-cast wheel. It would, therefore, seem that for practical purposes they must assume that a high casting temperature involved the raising of the solidification temperature.

Liquid Contraction.

As to liquid contraction, he could give some definite information obtained by casting ingots which were subsequently split and carefully measured to determine the volume of fluid contraction cavity. Certain ingots of basic electric steel, cast at a temperature which formerly pertained in the works he was visiting, showed a liquid contraction of 4.1 per cent. A very hot-cast example showed a liquid contraction of 4.5 per cent.; the cool-cast ingots had a liquid contraction of approximately 3 per cent. These ingots were cast at a speed somewhat in excess of the casting speed which pertained in most British works; therefore the "auto-feeding" of the lower levels of the ingots was not accomplished to anything like the normal extent. When considering steel castings, however, it should be remembered that the quenching effect of a sand mould was very much less than that of an ingot mould unless the section of metal being cast in a sand mould was very thin. It was fairly certain that the liquid contraction of basic electric steel was appreciably greater than that of converter steel of the same chemical composition, as indicated by a statement of the contents of carbon, silicon, manganese, sulphur, and phosphorus. This necessitated, provided identical methods of running were used, the imposition of larger risers or sink heads on castings produced from basic electric steel.

MR. T. MAKEMSON said it occurred to him that very high contraction would introduce fresh moulding troubles with steel castings, or complicate those which existed. Mr. Melmoth himself had pointed out that the moulders had noticed this, and insisted on a larger feeding head than was usually necessary. Perhaps Mr. Batty would tell them whether this excessive contraction had any other noticeable effect upon moulding troubles. They knew that in steel castings generally contraction did introduce all sorts of complications that did not occur in cast iron, and it occurred to him that the complications might be intensified by the excessive contraction with this particular type of electric steel castings.

He had always been under the impression that with the electric furnace one obtained castings of the highest quality, but at a corresponding price, largely owing to the very high cost of electric current. He therefore wished to ask how the cost of these castings compared with that of steel castings made by the converter process or the open-hearth process. He had an impression that the cost was higher. At the same time it was a practical fact that many firms, including Mr. Melmoth's and Mr. Batty's, who produced electric steel castings, were successfully competing with the producers of other types.

Actual Contraction Determined.

MR. BATTY said he had determined what he believed to be a true normal contraction of basic electric steel for the conditions which pertained in the foundry he controlled. Straight bars were moulded 12 in. long, 1 in. square, in cross-section. At each end of the mould a small metal stop was placed—being located contacting with the pattern—and the distance between these stops was carefully measured before the mould was closed. The resultant bars were measured in the cold condition at the points indicated by the metal stops, and at their normal casting temperatures they had a solid contraction of 2.406 per cent.

Cost of Electric Steel Castings.

With regard to cost, it must be admitted that, the electric furnace product was likely to be more expensive, because of the extra precautions which had to be taken to ensure mould collapse under the stress of the contracting casting. This did

* This Paper was printed in our last issue.

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not refer necessarily to cores, but to relieving the mould. Provision for eliminating almost entirely mould resistance might be achieved, in the case of many castings, by adjusting the composition of the moulding sand when green-sand production prevails, but with dry-sand moulds it was frequently necessary to take extra precautions to relieve the moulds. This involved extra expenditure, which affected the ultimate cost of the casting. Then again the provision of larger risers increased the proportion of discard and consequently reduced the proportionate yield of saleable castings in relation to weight of metal in ladle. He earnestly recommended a study of the methods which might be adopted in running castings; as a guide-post he would say that it was illogical to expect cool metal in a riser efficiently to feed hot metal in the body of a casting. Converter metal, he believed, was cheaper in the ladle than a high-grade basic electric steel; therefore, with the cost increments indicated, there could be no doubt that basic electric steel castings were a more expensive proposition. But it must not be forgotten that the castings in commerce, produced by the two methods under discussion, were by no means identical in composition. The basic electric steel was much purer, much freer from the deleterious constituents, sulphur and phosphorus. He felt that he was stating a fact in saying that basic electric steel castings were superior to those made by the converter process. He had in mind comparative destruction tests made by certain of their customers, such tests being amplified by observations on the properties of components throughout extended service.

The comparison with the cost of open-hearth steel castings could be made in the same way, taking the fundamental factor of the cost of metal in ladle, plus the cost increments indicated as being potentially applicable to electric steels.

Mr. Melmoth's Paper indicated, and he was able to support the statement, that steel must be carefully made in the basic electric furnace if losses from spongy castings were to be avoided. He quite agreed that a heat, high in silicon, cast at a high temperature, was likely to produce that form of unsoundness which was generally known as sponginess.

Then there was the liability to over-reduced steel in the electric furnace. That feature must be covered fully in its significance in relation to lack of fluidity and to its abnormal contraction, in addition to the liability, on certain occasions, to sponginess.

Fluidity.

Observations on a large number of heats of basic electric steel pointed to the conclusion that fluidity was related to the presence of a dissolved oxide or sub-oxide of iron in the liquid steel. One instance which occurred at Braintree was very significant, and pointed definitely to an association of dissolved oxide of iron with fluidity. A heat of electric furnace metal was tested for fluidity by taking a spoon sample from the bath, the sample being free from slag on the surface, and, counting in seconds, the time taken for the metal in the spoon to film over on the surface. This spoon time-test, as it was termed, was usually a fair indication of the way in which the metal would behave. In the specific case he was referring to a heat of 50 cwts. of metal, obviously very hot, would not give a spoon time-test of more than 22 seconds. Slag samples showed white, and were evidence of perfect reducing conditions. He would go further, and say that a perfectly white slag was evidence of over-reducing conditions. To this charge of 50 cwts. was added 1 cwt. of rusty plate scrap, the plates being approximately ½ in. thick. This scrap was rabbled into the bath, being very rapidly melted. A spoon sample taken within two minutes of adding the rusty scrap to the bath gave a time-test of 48 seconds. The "finishings," consisting of ferro-silicon and ferro-manganese, were added, and a spoon time-test taken four minutes thereafter gave a reading of 18 seconds. Here they would note the effect of the addition of silicon upon the fluidity or fluid life of the metal. This 50 cwts. heat was tapped into the ladle, 40 cwts. was subsequently distributed to the moulds on the casting floor by hand shanks, and the remaining half ton of metal was cast direct from the ladle into moulds. The whole of the metal ran cleanly from the ladle, and he was quite certain that very little of the heat could have been distributed by means of hand shank if it had been tapped before the addition of the oxide of iron on the scrap. It must be remembered that the addition of cold scrap must reduce materially the temperature of the bath, yet the fluidity increased enormously. The conclusion that fluidity was related to the presence, in an unknown quantity, of dissolved oxide of iron, had been supported in many subsequent instances, oxide being added either in the form of ore or in the form of mill scale. The use of rusty scrap applied when the bath was obviously very hot as well as sluggish.

Fluidity and Light Emission.

The peculiar behaviour of over-reduced electric steel in the hand-shank was a very serious thing in a foundry producing a large number of small castings which might not safely be produced by casting direct from the bottom-pour ladle; and it was imperative that the over-reduced condition be readily recognised and eliminated before the metal was tapped from the furnace. It was very easy to obtain, in the basic electric furnace, excessively strongly reducing conditions which caused the phenomenal behaviour of filming over in the hand-shank mentioned by Mr. Melmoth in the Paper. Some years ago Dr. McCance, in discussing the difficulties of bottom-pouring ingots of certain steels, especially chromium steels and high silicon steels, suggested that these steels gave up a great deal of their surface heat as light, and hence lost very rapidly their fluidity. It seemed to him that the steels of which Dr. McCance was speaking were, because of their composition, likely to be free from dissolved oxides, and that perfect reducing conditions, which were so readily obtainable in the electric furnace, served, in a mild steel, to eliminate such dissolved oxides as were assumed to be a normal constituent of converter or open-hearth steels.

MR. BATTY said a steel was considered to be reduced when free oxide of iron, such as would cause sponginess, was eliminated. The term "over-reduced" was possibly the shortest definition which indicated the elimination of dissolved oxide or sub-oxide of iron, which he assumed to be present in mild steels of the plain carbon type produced by the converter or open-hearth processes. In the basic electric furnace reducing conditions were brought about by a combination of ferro-silicon and powdered anthracite or other carbon medium. The general practice, after the oxidising slag had been removed, was to add sufficient silicon to deoxidise the bath, and to leave remaining approximately 0.10 per cent. silicon in the steel. Additions of carbon were made to the slag so that a smaller amount of silicon might efficiently deoxidise the steel, the silicon being the vehicle of the reaction. Briefly, "reduced" referred to a steel from which free oxide of iron has been eliminated, and "over-reduced" indicated a steel from which dissolved oxides, in addition to free oxides, have been eliminated. It was not claimed that the incidence of dissolved oxides was a fact, but it was claimed that a great deal of strong evidence could be adduced in support of the contention that fluidity in mild steels was related to the presence of an undetermined quantity of dissolved oxide of iron.

Spongy castings contained blowholes filled with gas which had been evolved by the steel. Mr. Melmoth had indicated in his Paper that analysis would show whether or not the steel was of a composition likely to be uncontaminated by free oxide of iron. A steel which contained in the liquid condition any appreciable amount of free oxide of iron was almost certain to produce spongy castings, and he suggested that this was due to an extraordinary capacity for gas solution by a mild steel, at a high temperature, containing appreciably more than the customary content of silicon. It was possible that a mild steel of a high-silicon content was, at high temperatures, involved in an encyclic reaction productive of free oxide of iron but such a theory was difficult of proof; probably a careful series of analyses covering the composition of the gases in the blowholes might throw a good deal more light on the subject. It was

probable that a very minute quantity of free oxide of iron might cause sponginess of a serious degree as a result of an initial reaction, probably in the range of temperature where the metal was just solidifying between oxide of iron and carbide of iron. Expressed simply this reaction read:—$FeO + Fe_3C = 4Fe + CO$.

This initial gas bubble might actually induce from solution in the metal a considerable volume of gas which would otherwise have been retained in solid solution.

Blows from cores or from corners of a mould were due to an entirely different set of circumstances, and should not be confused with any deficiency of the metal such as results in spongy castings. Mr. Melmoth made this point perfectly plain in his Paper.

Usually it was a matter of no difficulty to secure collaboration between a foundry and the designers employed by the foundry's customers, and his own experience was that such collaboration had made for him a number of friends. But there had been cases where the designer had refused to abate, in any particular whatsoever, his demands upon the foundry, with the result that the foundry had been involved in serious losses before the weight of fact compelled the designer to admit reluctantly that his proposition was impracticable. However, they must thank the designer for keeping them moving forward; in many cases the difficulties propounded by him had brought about a higher skill in moulding and the evolution of certain foundry expedients which otherwise might have remained undiscovered for a considerable time.

In the production of steel castings, chills, either external or internal, were used to promote uniformity in the temperature gradient of the casting. Another purpose for which they were used was to eliminate risers on certain parts of castings, such as bosses, the bosses being subsequently drilled or bared and the chill totally removed. If neither chill nor riser were applied there would be a contraction cavity in the boss which would create considerable difficulty in drilling the requisite hole. Of course certain internal chills were never removed by any subsequent machining operation on the casting, their function being to produce a uniformity of temperature in the casting and to maintain as nearly as practicable a uniformity in the temperature gradient of the casting, so as to avoid any undue stressing of the component.

Shape of Risers.

The shape of risers depended somewhat upon the method of running. One must never lose sight of the fact that steel freezes as a continuously thickening envelope, therefore risers should not be "necked." Otherwise there was a danger of feeding the neck sound but leaving the casting below the neck unsound.

The art of steel-making consisted very largely of a knowledge of a number of small details, and although one detail, by itself, might not appear to have great significance, its inter-relationship with other details demanded most careful scrutiny.

He regretted that he was not able to deal with the more abstruse scientific considerations involved so fully as Mr. Melmoth would have done. Some of the theories he had put forward might sound somewhat extravagant, but the application of them had led to definite valuable commercial results. Those responsible for the production of wealth in commerce might be content with an incomplete theory or definition, provided they were able to focus facts to the extent of securing reductions in costs of production. If they functioned as producers or conservors of wealth they must be content to be known by their works rather than by their words.

Super-Reduced Steels Loose Fluidity.

MR. G. C. GRANT stated that rustless steel castings were being successfully produced in Manchester, and it was found that the successful casting of this material was dependent upon the heat of the metal in the ladle and the method of running.

He substantiated Mr. Batty's remarks regarding the elements silicon, manganese and chromium in mild steel, and stated that a small percentage of titanium had a similar effect of turning what was obviously a hot heat and which normally would have run through a ¾-in. nozzle without difficulty, into a condition in which it was only got out of the ladle with difficulty. Although he was unable to ascribe the reason, the fact remained that super-reduced steels were less fluid.

MR. BATTY replied that he quite agreed that titanium, in common with certain other elements, was competent to eliminate dissolved oxide of iron and would therefore be likely to produce the sluggish over-reduced condition.

Vote of Thanks.

MR. J. S. G. PRIMROSE said it gave him great pleasure to move a vote of thanks to Mr. Melmoth and Mr. Batty for having put before the members an admirable Paper which covered a great deal of ground, the value of which they would be able to appreciate when they were able to study it in printed form. It was an interesting historical fact which not many people knew, that Messrs. Laske and Elliott of Braintree was the first firm in this country at whose works the electric furnace was used commercially for producing steel. Sheffield might have a claim to priority in respect to experimental work in that direction, but actual commercial production began at Braintree. There also the first electric non-ferrous metal furnace was started.

He would like Mr. Batty to give them a more precise explanation of what was meant by "over-reduced" steel.

MR. S. G. SMITH, in seconding the vote of thanks, said the troubles of the steel founder appeared to be very much akin to those experienced in the iron foundry, but probably in some phases they were intensified, due to the increase in liquid and solid contraction. He was in full agreement with Mr. Melmoth's suggestion that the designer of steel castings should serve a term in the steel foundry. It applied equally to the iron foundry, and he had advocated it for many years.

Mr. Melmoth did not appear to be entirely in favour of using chills, applied internally or externally, because troubles might arise from them. That was the impression made on his mind after listening to the Paper. What method could be substituted where it was desired to equalise solidifying conditions? It was assumed, of course, that the design of the pattern could not be altered.

Mr. Batty had stated that the utmost importance should be attached to the locality of the risers. This, again, applied equally to the iron foundry. Wherever it was possible the runners should be located at the parts that would cool first, thereby making the cooling of the casting more uniform and avoiding irregularities in shrinkage, both liquid and solid. To put the runners in the thick section of the casting was a mistake often made in the iron foundry.

The vote of thanks was passed unanimously.

Philadelphia takes Census of Foundry Iron.

The Philadelphia Foundrymen's Association is sending a questionnaire to foundries within a radius of 100 miles from Philadelphia to determine, if possible, the amount of foundry iron consumed in the Philadelphia district. The letter says that the inquiry is being made with the hope of locating further blast furnace facilities and by-product coke plants in or near Philadelphia. "There is no better place than Philadelphia," the letter says, "for assembling foreign ores." That port has favourable port charges, water and rail rates.

A project for the construction of a by-product coke plant and blast furnace on the Delaware River near Philadelphia has frequently been discussed in the pig-iron trade, but nothing tangible has come of it. Such a plant, it has been pointed out, would have the advantage of low costs on foreign ore, which could be unloaded right at its dock, and would also have low rail shipping rates to a large number of foundries.

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The Selling of Castings.—XXIV.

By VOYAGEUR.

Following-up Methods.

In the majority of systems for following up circular letters or inquiries the name of the potential purchaser is written on the card. This card is dealt with in different ways according to the kind of answer made by the customer. For example, if 2,000 cards are made out, being the total number to whom the first sales letter has been sent, 500 answers may be received. The respective 500 cards are taken out of the drawer in which they have been preserved, and are sorted out into other drawers in accordance with their character. For example, orders will go into one drawer, inquiries into another, definite refusals into a third, and so forth. There will then remain in the general drawer 1,500 cards representing those who have not answered the first sales letter. To these the second letter will be sent, after which a further set of replies will be received, and a further sorting out take place. Finally, there will remain an irreducible minimum of people who have received all the letters of the series, but who cannot be induced to reply.

A typical follow-up card is one which indicates the kind of details that need to be recorded. The manner in which cards can be differentiated from each other without being kept in separate drawers is detailed below. The system of keeping the cards ought first to be explained. A visible filing cabinet is used. The cards are all kept alphabetically in one cabinet in a set of trays. There is no need to take cards out of the trays to which they belong, as is necessary in the ordinary systems, such as that described at the beginning of this section.

When the first sales letter has been sent, a clerk makes out a card for each person to whom it has been despatched. The person's name and address are typed in at the bottom. This address is visible in the tray. In the space provided at the left-hand side is written the date on which the letter was sent and the title of any enclosure or booklet sent with it. If the letter is answered, this answer is handed to the clerk, who inscribes its date on the card. If orders are received, the card is marked as "dead," and retained in the file, a coloured signal being inserted opposite the space marked.

No cards for prospective customers who have not acknowledged the first letter are filed until the first following-up letter has been sent. Each day's batch of cards is kept in date order, behind those of the preceding period, assuming that letters are sent out continuously. In this way the cards to be followed up on any particular day will come automatically to the front on that day. Thus, if a dozen cards are made out on 3/7/25, these (assuming that a fortnight, as a reasonable period, is allowed to elapse between the sending of the first letter and the sending of the first following-up letter) are due to be followed up on 17/7/25. They are all kept together behind the cards for 2/7/25, which are due to be followed up on 16/7/25. As each day's cards fall due for following up, fresh ones for other and later dates are added at the back, so that eventually the 3/7/25 cards come to the top on 17/7/25, and are dealt with.

What occurs when the first following-up letter has been despatched? In many clumsy systems the cards are extracted from their drawers and filed in separate compartments. If an order is received they go into still another drawer. If no order follows, and a second follow-up letter is sent, yet another drawer is needed, and so on. But this method proves faulty in practice because often an order arrives from a customer who has had no literature, apparently. The clerk remembers his name slightly, and wonders if it appears on his cards. He wishes, if possible, to trace the order to its source in a particular letter or a particular advertisement. To find it he must wade through every classified drawer in order to make sure that it does not figure there. This means much time and labour, only too often skipped because of its tediousness. That means that eventually the customer who has ordered receives further circular letters that he does not need and that simply irritate him. In addition, postage, time, paper and money are all wasted.

It should be obvious that a follow-up system to be efficient should allow of all the cards being filed alphabetically in one set of drawers or trays only, whether the prospective customer be "live," "dead" or "in transit." Only one reference to a drawer or tray should be needful in order to discover whether a man's name figures on the cards. There should be no such thing as a "dead" drawer, a "first follow-up" drawer, and so on. In the system under discussion celluloid signals are employed. Divisions are printed at the foot of each card, and these divisions in the visible-filing system adopted can be seen without disturbing the cards.

As soon as the first follow-up letter is despatched a signal is inserted in a little space marked "first follow-up." Potential customers who acknowledge this letter but do not send orders receive a special letter, so that the signal for their cards is moved to the next compartment. If no acknowledgment is received, the second standard letter is sent, and the signal is moved accordingly. This goes on until all the letters have been sent out, when, if there has been no result, the signal is removed, indicating that the card is "dead."

The reason no cards are filed until the first follow-up letter has been sent is that as no signal is on them, there would be no means of distinguishing them from the "dead" cards, a "dead" card not needing a signal. It would, of course, be more difficult also if they were filed with the old cards to pick out the new ones when the time came to follow them up according to their date.

The advantage of the system described is that by reason of the signals all the cards for any particular follow-up letter can be picked out at once, yet all are kept together in alphabetical order, so that any individual card can be picked out without needless searching in a dozen different drawers or trays.

If an order is sent, the card becomes "dead" in the sense that no more follow-up letters are sent, but the broad details of the order are noted on the card for possible reference in the future.

It must be remembered that the system does not in itself constitute a mailing list in the strict sense of the word, *i.e.*, it is not the list of all possible purchasers of castings described in a previous article of this series. It is merely a "follow-up" system, and can be adapted to suit any circularising campaign, whether directed to a limited section of the market or aimed indiscriminately at all possible users of castings.

Application of the New Methods of Testing Castings.*

By LE THOMAS, Naval Engineer.

The author reviewed various methods for the mechanical testing of castings, and described how they had been applied at the Naval Works at Indret.

After pointing out the importance of securing the highest quality of castings for ships, the author referred to the researches made in connection with cast steel, and showed how the use of Portevin's triangular diagram and theoretical considerations had been justified by practical tests. These tests consisted in shearing tests (Falcot's machine, Frémont's machine); compression tests; static bending test (Frémont's machine); ball tests (Morin's apparatus); micrographical examination; chemical analysis; thermal analysis (with Chevenard's dilatometer). On the basis of these tests he laid down certain specific requirements as to mechanical castings intended for the Navy, which he divided into five classes: Extra strong (more than 14.6 tons); strong (more than 12 tons); ordinary (more than 9.5 tons); castings for special purposes; and common castings.

MR. RONCERAY thanked the author on behalf of the Testing Committee for having secured the adoption by the French Navy of the methods recommended by that Committee. These methods were also being adopted by the railways and by important companies. The Compagnie des Chemins de Fer de l'Est had made 350 tests, which showed the ratio Rt = 0.75 Rs, in which Rt = tensile strength and Rs = shearing strength.

* Abstract of a Paper read before the Franco-Belgian Foundr Congress.

MACNAB & Co.

TABOR MOULDING MACHINES (TABOR PATENTS)

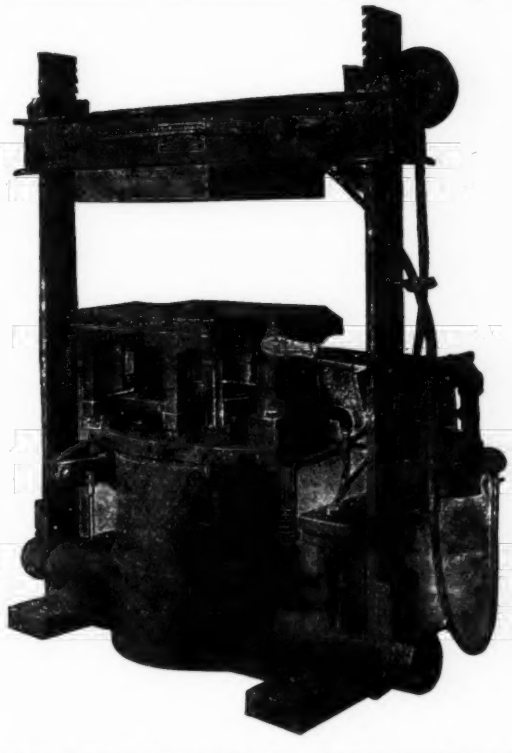
For Every Class of Work.

Pit Type and Portable Combination Shockless Jar Ramming Power Roll-over and Pattern Drawing Machines; Power Squeezing and Jar Squeezing Machines; Shockless Jarring Machines, etc., etc.

SPECIAL FEATURES AND ADVANTAGES:

Accurate Definite Draw with Permanent Accurate Alignment.

All Operations Controlled by One Lever.



Uniformity in size of Castings produced.

All Moulds squeezed alike to whatever Pressure Required.

Minimum Percentage of Wasters.

The above illustrates the TABOR POWER SQUEEZING "SPLIT PATTERN" MOULDING MACHINE, specially suitable for all small patterns which can be split in halves or for flat back Work.

A customer writes—
"The Machines draw perfectly in producing deep castings with the minimum amount of taper, and we are fully satisfied with them, as they are most economical in use and give the maximum production."

Capacities and Dimensions furnished upon application:

56/8, Eagle Street, Southampton Row, London, W.C.1.

Works: TOTTENHAM, LONDON, N.17.

Trade Talk.

OPERATIONS HAVE BEEN started at the South African Bolt and Nut Factory.

OERLIKON, LIMITED, have removed to larger and more commodious premises at Oerlikon House, 28-31, Essex Street, Strand, W.C.2.

JOSEPH KAYE & SONS, LIMITED, Lock Works, Leeds, have booked a further order for their new patent force-feed oilcans from the British Admiralty.

HOWDEN-LJUNGSTROM PREHEATERS (LAND), LIMITED, have shipped two large air preheaters to work in conjunction with two B. & W. boilers to Natal, South Africa. The total heating surface of the preheaters is 43,100 sq. ft.

THE IMPORTS OF FOREIGN IRON ORE at the Senhouse Dock at Maryport for the last quarter of 1925 amounted to 14,800 tons, compared with 28,300 tons for the previous three months, and 14,240 tons at the corresponding period of last year.

SHORT BROTHERS, LIMITED, of Sunderland, have contracted to build two vessels, each of 10,000 tons dead-weight, for the managers of the Nitrate Producers Company, London. The engines will be built by the North-Eastern Marine Engineering Company, Limited.

WHEATLEY, KIRK, PRICE & COMPANY have received instructions from the receiver for the debenture holders to sell by auction the shipbuilding yard and engineering works of Ritson's Shipbuilding & Engineering Company, Limited, at Blyth. The yard has an area of 22 acres.

HADFIELDS, LIMITED, East Hecla Works, Tinsley, Sheffield, have been appointed as official contractors to the Irish Free State for stone crushing plant. During the last seventeen months the company have supplied nineteen complete portable crushing plants to the county surveyors in the Irish Free State.

THE ANNUAL DANCE in aid of the benevolent fund of the Royal Metal Trades' Pension and Benevolent Society, the offices of which are at 195, Upper Thames Street, London, E.C.4, will take place in the Grand Hall, at the Hotel Cecil, Strand, London, W.C.2, on Friday, January 15 next. Mr. Sydney Harvey will be the chairman of the evening.

EDWARD WOOD & COMPANY, LIMITED, Ocean Ironworks, Manchester, have secured the order for about 4,000 tons of steelwork in connection with the erection of a new telephone exchange at Salford. The same firm have also obtained orders for the supply and erection of the steelwork required for a new bridge to be built at Heysham by the London, Midland and Scottish Railway Company.

THE BURNTISLAND SHIPBUILDING COMPANY, LIMITED, have received an order for a special type steamer required by the Wandsworth, Wimbledon and Epsom District Gas Company, for the carriage of coal from North of England ports to the works at Wandsworth. The vessel is practically a duplicate of one built for the same owners last year by the Burntisland Company.

ORDERS HAVE BEEN PLACED with John Cran & Somerville, Limited, Leith, for two large tugs, complete with machinery. One of the tugs is to the order of the Crown Agents to the Colonies, and is to be equipped with engines of over 800 i.h.p., salvage and fire pumps, steam auxiliaries throughout, and electric light. The other is for the Alexandra Towing Company, Limited, of Liverpool, and is to be 105 ft. long, being fitted with triple expansion engines of about 1,200 i.h.p., supplied with steam at 200 lbs. pressure, steam auxiliaries throughout.

The Institution of Fuel Economy Engineers.

A new institution has been formed to deal in a scientific manner with the problem of preparing and utilising our fuel resources with much greater efficiency. This new organisation is called the Institution of Fuel Economy Engineers, which was inaugurated at a meeting of experts at the Engineers' Club, London. Among those taking part in the proceedings were Dr. T. Barratt, Professor Bacon, Mr. W. C. Goodchild (representing Sir Henry Fowler), Dr. R. Lessing, Mr. E. W. L. Nicol, Mr. John Bruce, Mr. S. W. Bettoney, Mr. J. S. Gander, and Mr. A. C. Mahar. The first council was elected, and it was decided to form sections in different parts of the country. The ideal behind this new Institution is that it shall be the responsible organisation representing every section of fuel technology throughout the country, and shall be able to speak with authority on each of our fuel problems. The secretary is Mr. H. L. Pirie, and the registered office of the Institution is 29, Sherwin Road, Lenton, Nottingham, pending the opening of London headquarters.

Personal.

MR. H. F. WALKER has been elected chairman of the Nantyglo and Blaina Ironworks, Limited, in place of the late Mr. S. Mason. Mr. G. A. Cave Orme has been elected a director of the company.

MR. W. CLARK, who has resigned his position as managing director of Vickers, Limited, River Don Works, Sheffield, has been the recipient of a handsome presentation from the directors, managers and staff.

MR. JOHN WILLIAMS, superintendent of the London, Midland & Scottish and Great Western Joint Railways at Shrewsbury, is shortly retiring. The companies named have under consideration a scheme for dividing the supervision of the joint lines between them.

Wills.

TAYLOR, C. H., of Oval Road, Gravelly Hill, Birmingham, steel manufacturer £12,329

PRESCOTT, H., of Hazelcroft, Fairlawn Road, Lytham, Lancashire, engineer... £52,695

New Companies.

Breeden & Company, Limited, New Mill Works, Fazeley Street, Birmingham.—Capital £1,000 in £1 shares. Iron, steel and brass founders, etc. Director: W. J. G. Sperryn.

Brunswick Metal Casement and Engineering Company, Limited.—Capital £2,000 in £1 shares. Directors: W. E. Plaister, 632, High Road, Tottenham, N.17; W. F. Ward, and E. J. Kerslake.

Everett & Company, Limited, 117, Montague Road, Reading.—Capital £3,000 in £1 shares (1,000 6 per cent. cum. pref.). Sheet metal workers, etc. Directors: C. Richardson and C. D. Everett.

Geo. Heritage Smart, Limited, 10, Queen Road, Coventry.—Capital £1,000 in £1 shares. Engineers. Directors: G. H. Smart and S. H. Stevens.

Stern & Bell, Limited, Camden Forge, Camden Drive, Birmingham.—Capital £4,500 in £1 shares. Engineers. Directors: T. Bell and Mrs. Ruth M. Bell.

Sulron, Limited, Norfolk House, 36, Cannon Street, Birmingham.—Capital £100 in £1 shares. Metallurgical and foundry specialists, etc.

Obituary.

MR. F. COTTERELL, of Walsall, died on December 24, at the age of 62. He carried on the business of an ironfounder.

MR. J. MUSGROVE died on December 25, at Nile House, Workington, at the age of 69 years. Mr. Musgrave was a native of Workington, and had been in the foundry business all his life, succeeding to the control of the Nile Foundry on the death of his father.

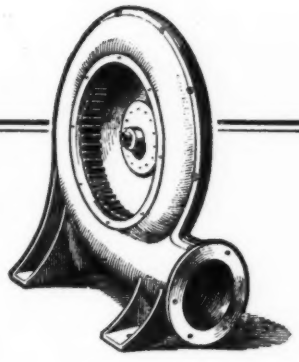
MR. J. E. BAKER, whose death has occurred in Ceylon, was vice-chairman of Davy Brothers, Limited, of Sheffield, chairman of the Sheffield District Engineering Trades Employers' Federation, and a member of the Council of the Sheffield Chamber of Commerce.

MR. E. E. J. ROBERTS has died at his residence, The Laurels, Brierley Hill, Staffs. He was a son of the late Mr. C. Roberts, one of the founders of Roberts & Cooper, Limited, who had ironworks in various parts of the Midlands, and only recently Mr. Roberts acquired the Nine Locks Sawmills.

MR. F. T. G. WALTON, who died at his residence in St. George's Court, Gloucester Road, Kensington, London, on December 21, had a distinguished career in India as a railway engineer. Some of the most important railway systems and bridges in India were built under his direction. He was a member of the Institution of Civil Engineers.

MR. O. SCHENK, who was for over a quarter of a century engineer to the Swansea Harbour Trust, only retiring on the Great Western Railway Company taking over the docks undertaking, died on Tuesday, aged 77. Mr. Schenk was chief of the engineering staff to the contractors of the Severn Tunnel, was also engaged on the Manchester Ship Canal, and undertook engineering works at Buenos Aires for the Argentine Government. In conjunction with Mr. P. M. Meik, he carried out the engineering work of the Swansea New King's Dock.

MR. E. W. JOHNSTON (King's College Hospital) has been elected president of the Diesel Engine Users' Association for the ensuing year. Messrs. F. A. Greene and C. F. Mounsdon have been elected to fill the vacancies on the general committee of the Association, and Messrs. P. Still and G. Porter have been re-elected joint honorary secretaries.



TRADE SIROCCO MARK

High-Pressure Fans

Single Inlet Cupola Fans

These Fans are suitable for Cupola work up to 30-in. Water Gauge at moderate speeds of revolution.

Cast-Iron High-Pressure Fans

Suitable for Forges or other work calling for static pressures up to 16-in. Water Gauge

Narrow Pressure Fans

Give a small volume of air at static pressures up to 30-in. Water Gauge for general high-pressure work

Double Inlet Cupola Fans

Suitable for Cupola or other work calling for static pressures up to 30-in. Water Gauge.

DAVIDSON & Co. LIMITED

SIROCCO ENGINEERING WORKS - BELFAST

To FOUNDERS of DISCERNMENT

THE NAME OF

WM. CUMMING & CO., LTD.

OF MARYHILL, GLASGOW,

STANDS FOR

QUALITY, DEPENDABILITY, SERVICE

FOR 85 YEARS WE HAVE BEEN MANUFACTURING

FOUNDRY FACINGS

AND OUR

METHODS HAVE ADVANCED WITH THE TIMES

Branch Works at :—CHESTERFIELD, DEEPFIELDS, FALKIRK & MIDDLESBROUGH.

IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—With the advent of the New Year, the Cleveland iron market is experiencing a general all-round advance in prices of 2s. per ton, due to the growing scarcity of supplies following an unexpectedly heavy demand by consumers, which continued right up to the adjournment for the holidays. This upward movement in values has been necessitated by the continued rise in fuel costs, and is compulsory on makers as a measure of protection against renewed losses on production. Makers at the moment, however, are substantially booked on forward contracts, and are consequently hard pressed for deliveries on recent commitments, though it is not anticipated that these conditions will check the increasing demand to any material extent. As to the export trade, the advance in prices must necessarily lessen further the chances of competing with the Continent, but producers have, no doubt, weighed up the prospects, and have decided to make the best of the improvement in the home trade. Prices now stand as follow:—No. 1, 71s. 6d. per ton; No. 3 G.M.B., 69s.; No. 4 foundry, 68s.; No. 4 forge, 67s. These are f.o.b. export prices. Home prices are 6d. per ton less.

In the Tees-side hematite market there are now no prompt supplies available, and preparations are well in hand to increase production, and this may afford a little relief, but otherwise on the present scale of output, if the current demand holds, the scarcity looks like being very acute. For East Coast mixed numbers 76s. 6d. is now quite a minimum figure, with 6d. per ton more for No. 1. On the North-West Coast prices continue firm, with Bessemer mixed numbers £4 1s. 6d. c.i.f. Welsh ports, £4 5s. per ton delivered at Glasgow, £4 8s. 6d. per ton delivered at Sheffield, and £4 12s. 6d. per ton delivered at Birmingham.

LANCASHIRE.—Though still comparatively quiet, the local markets for foundry pig are distinctly gaining strength, and it is quite expected that quotations will be shortly advanced. The nominal prices for No. 3 foundry iron are 73s. 6d. to 74s. for Derbyshire and 72s. 6d. to 73s. for Lincolnshire brands. There are one or two sellers of Derbyshire who try for a little more than 74s., but in these cases the make is small. The larger makers will still sell at 73s. 6d., delivered in Manchester and the district.

THE MIDLANDS.—The postponement of the Birmingham quarterly meeting until the 14th inst. has somewhat upset calculations as to the probable course of business in the immediate future, but as regards foundry pig, the demand is certainly on a steadily increasing scale, with quotations firm, as follow:—Derbyshire No. 3 foundry, 65s. to 66s.; Staffordshire No. 3 foundry, 65s.; Northants No. 3 foundry, 62s. 6d.

SCOTLAND.—Movements in the Scottish markets for foundry pig have been practically in abeyance during the past fortnight, but hopes are entertained that the better conditions in the Southern centres of trade may have a beneficial effect in this area when works are again in full swing. In the meantime the year closed with Scotch No. 3 foundry iron quoted down to 76s. at furnaces, the lowest figure recorded during 1925.

Scrap.

Interest in the markets for scrap metal, though slow in reviving, is distinctly on the increase, and on Tees-side last week a few transactions in cast material were noted at prices as follow:—Heavy cast-iron borings, 42s. 6d.; heavy machinery cast-iron scrap in handy pieces, 67s. 6d.; ordinary cast-iron scrap, 62s. 6d.; bushelling scrap, 67s. 6d. All these prices include delivery at works. In Scotland only a quiet business is passing, with cast-iron borings quoted at 47s. 6d. to 49s. per ton; machinery cast-iron scrap, 74s. 6d. to 75s. per ton; ordinary cast-iron scrap to the same specification, i.e., in pieces not exceeding 1 cwt., 67s. 6d. per ton; old cast-iron railway chairs, 73s. 6d. to 74s. per ton; and light cast iron and firebars, 57s. 6d. per ton. The above prices are all per ton, delivered f.o.t. consumers' works.

Metals.

Copper.—Following the recent rather surprising spurt in copper prices has ensued a much quieter period, the metal meantime falling to a much lower level. It is not, however, expected that for the present the price of the metal will drop much further even under adverse outside influences, and it is quite on the cards that the set-back will be made good almost immediately, when the trade demand at any rate should develop rather more freely. Consumers, for one thing, have been buying from hand to mouth for a long while past, and therefore have but little metal in the disposal. Current quotations:—*Cash*: Thursday, £59 12s. 6d.; Monday, £59 15s.; Tuesday, £59 15s.; Wednesday, £59 10s.

Three Months: Thursday, £60 12s. 6d.; Monday, £60 15s.; Tuesday, £60 15s.; Wednesday, £60 10s.

Tin.—Movements in standard tin, since the resumption of markets, have again further strengthened the position, based on anticipation of satisfactory statistical developments over the end of the year, and of the continuation of a large consumptive demand for some months to come at any rate. Near tin is so well under control that attempts made to cover contracts for January dates at once resulted in a rapid increase in the premium on cash tin to £7 a ton. The demand from America is good, although prices have eventually eased off there, having, however, no effect on the London markets. Current quotations:—*Cash*: Thursday, £289 2s. 6d.; Monday, £289; Tuesday, £288; Wednesday, £288.

Three Months: Thursday, £281 12s. 6d.; Monday, £281 10s.; Tuesday, £281 7s. 6d.; Wednesday, £280 15s.

Spelter.—The position of this metal is accurately outlined in the following extract from a trade circular: "The tendency has been for the backwardation to decrease slightly. Near delivery has been rather neglected, interest centring chiefly in February and March shipments. Demand on the part of consumers has been dull, but, on the other hand, there has been no pressure to sell. Fundamental conditions remain unchanged; the firm undertone is well maintained, but with buyers and sellers alike showing little disposition to deal, the market presents no very definite tendency. Current quotations:—*Ordinary*: Thursday, £38 12s. 6d.; Monday, £39; Tuesday, £38 18s. 9d.; Wednesday, £38 15s.

Lead.—The market for soft foreign pig continues the improving tendency previously noted, with values generally firmer. Home demand is in fair volume, but the Continental inquiry has remained comparatively light. At this time last year the market was soaring, but there was then a scarcity of supplies which does not now exist, and even at the current figure the metal might be regarded as rather dear, considering that the consumptive demand is not so good as it was months ago. Current quotations:—*Soft foreign (prompt)*: Thursday, £35 10s.; Monday, £35 15s.; Tuesday, £35 10s.; Wednesday, £35 6s. 3d.

DIXON, STACEY & CO.,

(CROOKE & CO., LTD., Proprietors.)

34/35, NORFOLK STREET, STRAND, LONDON, W.C.2.

REFRACTORY MANUFACTURERS.

A Super Refractory manufactured by us in various consistencies to suit founders' varying conditions.

Incomparable for the Lining of Cupolas, Steel Converters, Ladles, Pit Fires, Brick Setting, Etc.

For Plugging and Ramming, our Pure Silica Quartz Silcrete has no equal.

SILCRETE (Registered).

It costs you about one half the price of Sheffield Ganister and Patent Furnace Linings, and lasts twice as long.

Used by some of the Principal Steel and Iron Founders, for its melting Point is far higher than all others. Reduces slagging. Practically Abrasion proof.

SILCRETE IS MANUFACTURED IN ENGLAND UNDER PRACTICAL AND EXPERT SUPERVISION.

"GLUTRIN" STANDS ALONE

THE WORLD'S FINEST CORE BINDER

After twenty years Foundry Service
it is still going strong.

Economise in production by using
"GLUTRIN"
and thus cutting out wasters.

"GLUTRIN" IS WORTH A TRIAL
IT MEANS YOUR ORDER TO US.

WHY NOT?

Full particulars from the following stockists:

MIDDLESBROUGH:
Messrs. Thomas Wilkinson & Co., Ltd.,
Stockton Street, Middlesbrough.

LONDON:
Messrs. The Blackfriars Foundry
Requisite Co., Ltd.,
34/35, Norfolk Street, London, W.C.2.

GLASGOW:
Messrs. Albert Smith & Co.,
Foundry Engineers, etc.,
60, St. Enoch Square, Glasgow.

BLACKING,
PLUMBAGO,
CORE GUM,
WHITE DUST,
COAL DUST.

ESTABLISHED 1863

JAS. DURRANS & SONS, LTD.

PHOENIX WORKS, PENISTONE, near SHEFFIELD.

Telephone:
21 PENISTONE.

Telegrams:
"DURRANS, PENISTONE."

Manufacturers of

FOUNDRY EQUIPMENTS

LADLES,
FIRE BRICKS,
STONE FLUX,
CASTING CLEANERS,
PIPE NAILS,
SPRIGS,
WIRE BRUSHES,
BELLOWS,
CUPOLAS,
GANISTER,
LOAM AND SAND MILLS,
STUDS,
CHAPLETS,
BRUSHES,
CORE ROPES.
BUCKETS,
SPADES, Etc.

Write for Illustrated Catalogue on Blacking and Foundry Requisites, also for our latest Price List.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	59	10	0
Three months	60	10	0
Electrolytic	65	15	0
Tough	62	15	0
Best selected	63	15	0
Sheets	90	0	0
India	75	0	0
Wire bars	66	5	0
Do. Jan.	66	5	0
Do. Feb.	66	5	0
Ingot bars	65	10	0
H.C. wire rods	70	0	0
Off. av. cash, Dec. 59	12	0	6/11
Do., 3 mths. Dec. 60	12	10	1/11
Do., Sttlmnt, Dec. 59	11	9	6/11
Do., Electro, Dec. 65	16	8	5/11
Do., B.S., Dec.	64	7	0
Aver. spot price copper, Dec.	59	11	10
Do., wire bars, Dec. 66	0	11	
Solid drawn tubes			13d.
Brazed tubes			13d.
Wire			10d.

BRASS.

Solid drawn tubes	12d.
Brazed tubes	13½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g	10½d.
Wire	10½d.
Rolled metal	9½d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	288	0	0
Three months	280	15	0
English	287	0	0
Bars	289	0	0
Straits	289	0	0
Australian	289	0	0
Eastern	287	0	0
Banca	294	0	0
Off.aver. cash, Dec. 285	1	0	2/11
Do., 3 mths., Dec. 279	3	8	7/11
Do., Sttlmt. Dec. 285	0	5	5/11
Aver. spot., Dec. 285	0	5½	

SPELTER.

	£	s.	d.
Ordinary	38	15	0
Remelted	37	7	6
Hard	32	5	0
Electro 99.9	42	12	6
English	39	12	6
India	33	10	0
Zinc dust	46	0	0
Zinc ashes	15	10	0
Off. aver., Dec.	37	17	9/11
Aver., spot, Dec.	38	6	6½

LEAD.

	£	s.	d.
Soft foreign ppt.	35	6	3
English	36	15	0
Off. average, Dec.	34	11	10/11
Average spot, Dec.	34	14	9¼

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	46	0	0
Do. V.M. ex whf.,	45	0	0
Rods	52	0	0
Boiler plates	44	0	0
Battery plates	44	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	100	0	0
Chinese	98	0	0
Crude	65	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	15	0	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro silicon	
25%	£9 10 0
45/50%	£11 15 0
75%	£21 10 0
Ferro-vanadium—	
35/40%	15/3 lb. va.
Ferro-molybdenum—	
70/75% c. free	6/1 lb.
Ferro-titanium—	
23/25% carbonless	1/1 lb.
Ferro-phosphorus, 20/25%,	£20 0 0
Ferro-tungsten—	
80/85%, c.fr.	1/8 lb. to 1/8½
Tungsten metal powder—	
98/99%	1/11 to 2/- lb.
Ferro-chrome—	
2/4% car.	£34 5 0
4/6% car.	£23 7 6
6/8% car.	£23 0 0
8/10% car.	£22 7 6
Ferro-chrome—	
Max. 2% car.	£40 10 0
Max. 1% car.	£49 0 0
Max.0.70% car.	£56 10 0
70%, carbonless	1/5 lb.
Nickel—99%, cubes or pellets	£172 to £177
Cobalt metal—98/99%	10/- lb.
Aluminium 98/99%	£120
Metallic Chromium—	
96/98%	3/6 lb.
Ferro-manganese (net)—	
76/80%, loose	£15 7 6
76/80%, packed	£16 7 6
76/80%, export	£15 5 0
Metallic manganese—	
94/96%, carbonless	2/- lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	2	6
Finished bars, 18% tungsten	3	0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. and over	4d.lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb.
Do. under ¼in. to 3/16 in.	1/- lb.
Flats, ½in. × ¼in. to under 1 in. × ⅜ in.	3d. lb.
Do. under ½in. × ¼in.	1/- lb
Bevels of approved sizes and sections	6d. lb.
Bars cut to length	10% extra
Scrap from high-speed tool steel—	
Scrap pieces	3d.
Turnings and swarf	1d.

Per lb. net, d/a steel makers' work

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Hvy. steel	3	7	6	3	10	0
Bundled steel & shrngs.	3	2	6	to 3	5	0
Mixed iron & steel	3	0	0	to 3	2	6
Heavy cast iron	3	2	6	to 3	5	0
Good machinery for foundries	3	7	6	to 3	10	0
Cleveland—						
Heavy steel	3	10	0	to 3	11	0
Steel turnings		2	5	0		
Cast iron borings		2	2	6		
Heavy forge		4	2	6		
Bushelled scrap		3	7	6		
Cast-iron scrap		3	2	6		
Lancashire—						
Cast-iron scrap		3	10	0		
Heavy wrought		3	7	6		
Steel turnings		2	0	0		
London — Merchants' buying prices delivered yard.						
Copper (clean)		52	0	0		
Brass (clean)		39	0	0		
Lead (less usual draft)		31	0	0		
Tea lead		27	0	0		
Zinc		25	0	0		
New aluminium cuttings		92	0	0		
Braziery copper		46	0	0		
Gunmetal		45	0	0		
Hollow pewter		190	0	0		
Shaped black pewter		140	0	0		

PIG-IRON.

(f.o.t. unless otherwise stated).

N.E. Coast—	
Foundry No. 1 *	71/-
Foundry No. 3	68/6
Foundry No. 4	67/6
Forge No. 4	66/6
Hematite No. 1	77/6
Hematite M/Nos.	77/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	85/-
,, d/d Birm.	92/6
Midlands—	
Staffs com iron*	—
,, No 4 forge	60/-
,, No. 3 foundry	65/-
Shrops. basic	70/-
,, Cold blast, ord.*	185/-
,, ,, roll iron*	190/-
* d/d Birmingham.	
Northants forge	55/-
,, fdry No. 3	62/6
Derbyshire forge	59/6
,, fdry. No. 3	65/6
,, basic	65/-
Scotland—	
Foundry No. 1	81/6
,, No. 3	76/6
Hem. M/Nos.	77/6
Sheffield (d/d district)—	
Derby forge	63/6
,, fdry. No. 3	69/-
Lincs. forge	68/-
,, fdry. No. 3	70/-
E.C. hematite	87/-
W.C. hematite	90/-
Lincs. (at furnaces)—	
Forge No. 4	60/-
Foundry No. 3	62/-
Basic	62/-
Lancashire (d/d eq. Man.)—	
Derby forge	67/-
,, fdry. No. 3	73/6
Northants foundry No. 3	75/3
Dalzell, No. 3	110/-
Summerlee, No. 3	94/-
Glengarnock, No. 3	94/-
Gartsherrie, No. 3	94/-
Monkland No. 3	94/-
Coltness, No. 3	94/-
Shotts, No. 3	94/-

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars(cr.)	11	5	0	to 12	10	0
Angles				11	10	0
Tees to 3 united ins.				12	0	0
Nut and bolt				10	15	0
Hoops	14	0	0	to 15	0	0
Marked bars (Staffs.) f.o.t.				14	0	0
Gas strip	12	10	0	to 12	15	0
Bolts and nuts ¾ in. × 4 in.				16	15	0
Steel—						
Ship plates	7	5	0	to 7	17	6
Boiler plts.				11	10	0
Chequer plts.	£9	5	to	9	15	0
Angles	£6	17	6	to 7	5	0
Tees	£8	0	0	to 8	5	0
Channels	£6	12	6	to 7	2	6
Joists	£6	17	6	to 7	5	0
Rounds and Squares 3 in. to 5½ ins.				8	7	6
Rounds under 3 in. to ¾ in.				8	2	6
Flats, over 5 in. wide and up				8	17	6
Flats, 5in. to 1½in.				7	17	6
Rails, heavy				8	0	0
Fishplates				12	0	0
Hoops (Staffs.)				10	10	0
Black sheets, 24g.				11	5	0
Galv. cor. sheets, 24g.				16	15	0
Galv. fencing wire 8g. plain				14	0	0
Billets, soft	£6	0	0	to 7	5	0
Billets, hard				8	2	6
Sheet bars				6	5	0
Tin bars d/d				6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	3½
Rods	1	3
Tubes	1	8½
Castings	1	2

Delivery 3 cwt. free

10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.

C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	24.26
No. 2 foundry, Valley	22.26
No. 2 foundry, Birm.	22.00
Basic	21.76
Bessemer	22.76
Malleable	22.26
Grey forge	21.76
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.50
Sheets, black, No. 28	3.35
Sheets, galv., No. 28	4.60
Sheets, blue an'l'd, 9 & 10	2.50
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry	32/6 to 37/6
,, furnace	20/- to 25/-
Durham & North.	
,, foundry	30/- to 33/-
,, furnace	18/- to 18/6
Other Districts, foundry	30/- to 33/-
,, ,, furnace (basis)	11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	19/9
,,	28×20, ,,	39/6
,,	20×10, ,,	29/1½
,,	18¾×14, ,,	20/3
C.W.	20×14, ,,	18/3
,,	28×20, ,,	36/3
,,	20×10, ,,	25/-
,,	18¾×14, ,,	18/7½

Terneplates 28 × 20, 36/- per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£19/0 to £20/0
Rolled Ord.	£16/0/0 to £16/10/0
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12

Pig-iron £6 15 0 to £7 0 0 all f.o.b. Gothenburg.

TUBES.

Up to and incl. 6 in.

Gas .. 55% } Tube prices
Water .. 50% } are
Steam .. 45% } now free.

Electrolytic Copper.

	£	s.	d.	
Dec. 31	65	15	0	inc. 15/–
Jan. 4	65	15	0	No change
,, 5	65	15	0	,, ,,
,, 6	65	10	0	dec. 5/–

Tin (English ingots).

	£	s.	d.	
Dec. 31	288	0	0	inc. 30/–
Jan. 4	288	0	0	No change
,, 5	287	0	0	dec. 20/–
,, 6	287	0	0	No change

Spelter (ordinary).

	£	s.	d.	
Dec. 31	38	12	6	dec. 2/6
Jan. 4	39	0	0	inc. 7/6
,, 5	38	18	9	,, 1/3
,, 6	38	15	0	dec. 3/9

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Dec. 31	59	12	6	inc. 5/–
Jan. 4	59	15	0	,, 2/6
,, 5	59	15	0	No change
,, 6	59	10	0	dec. 5/–

Standard Tin (Cash).

	£	s.	d.	
Dec. 31	289	2	6	inc. 27/6
Jan. 4	289	0	0	dec. 2/6
,, 5	288	0	0	,, 20/–
,, 6	288	0	0	No change

Zinc Sheets (English).

	£	s.	d.	
Dec. 31	46	0	0	No change
Jan. 4	46	0	0	,, ,,
,, 5	46	0	0	,, ,,
,, 6	46	0	0	,, ,,

Lead (English).

	£	s.	d.	
Dec. 31	36	15	0	inc. 5/–
Jan. 4	37	0	0	,, 5/–
,, 5	37	0	0	No change
,, 6	36	15	0	dec. 5/–

AVERAGE MONTHLY PRICES OF IRON HOOPS.

	Jan.			Feb.			March.			April.			May.			June.			July.			Aug.			Sept.			Oct.			Nov.			Dec.			Yearly average.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
1896	6	2	6	6	2	6	6	2	6	6	2	6	6	2	6	6	2	6	6	2	6	6	2	6	6	2	6	6	2	6	6	5	0	6	10	0	6	3	4
1897	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0
1898	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	10	0	6	15	0	6	15	0	7	0	0	6	11	8
1899	7	0	0	7	0	0	7	0	0	7	0	0	7	12	6	10	12	6	8	12	6	8	12	6	8	12	6	9	2	6	9	7	6	9	17	6	8	2	6
1900	9	17	6	10	7	6	10	7	6	10	7	0	10	12	6	7	12	6	10	12	6	10	12	6	10	12	6	9	17	6	9	2	6	9	2	6	10	3	9
1901	9	2	6	8	2	6	8	2	6	7	12	6	7	12	6	7	12	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	11	8
1902	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6
1903	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6
1904	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6	7	2	6
1905	6	17	6	7	0	0	7	0	0	7	0	6	7	0	0	7	0	0	7	2	6	7	2	6	7	2	6	7	7	6	7	0	0	7	7	6	7	1	8
1906	7	10	0	7	17	6	7	15	0	7	15	0	7	15	0	7	15	0	7	15	0	7	15	0	7	15	0	7	15	0	7	15	0	8	7	6	7	15	10
1907	8	7	6	8	7	6	8	7	6	8	7	0	8	7	6	8	7	6	8	10	0	8	10	0	8	10	0	8	5	0	8	5	0	8	0	0	8	7	1
1908	8	0	0	7	10	0	7	10	0	7	10	6	7	10	0	7	10	0	7	10	0	7	0	0	7	0	0	7	0	0	7	0	0	7	0	0	7	6	8
1909	7	0	0	7	0	0	7	0	0	7	0	0	7	0	0	7	0	0	7	0	0	7	0	0	7	0	0	7	0	0	7	0	0	7	0	0	7	0	0
1910	7	1	10½	7	6	3	7	7	6	7	7	0	7	7	6	7	7	6	7	7	6	7	7	6	7	7	6	7	6	3	7	5	0	7	5	0	7	6	5½
1911	7	5	0	7	5	0	7	5	0	7	5	6	7	5	0	7	5	0	7	5	0	7	5	0	7	5	0	7	8	9	7	10	0	7	10	0	7	6	1½
1912	7	12	6	7	12	6	7	12	6	7	15	0	7	15	0	8	2	6	8	2	6	8	2	6	8	12	6	8	12	6	8	12	6	8	15	0	8	2	3½
1913	8	17	6	8	17	6	8	17	6	8	17	0	8	17	6	8	17	6	8	17	6	8	7	6	8	7	6	8	7	6	8	7	6	7	17	6	8	12	6
1914	7	17	6	7	17	6	7	17	6	7	13	9	7	12	6	7	12	6	7	12	6	9	2	6	9	2	6	9	2	6	9	2	6	9	2	6	8	6	4½
1915	9	3	6	9	18	1	10	7	6	10	16	6	10	17	6	13	2	6	13	2	6	13	2	6	13	7	6	14	2	6	15	2	6	15	18	6	12	10	1½
1916	17	2	6	17	2	6	17	2	6	17	6	3	17	7	6	17	7	6	17	7	6	17	7	6	17	7	6	17	7	6	17	7	6	17	7	6	17	6	1½
1917	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6
1918	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6	17	2	6
1919	17	2	6	17	2	6	17	2	6	17	2	6	24	6	3	24	6	3	24	6	3	25	9	0	26	7	6	26	7	6	26	7	6	26	17	4	22	14	9
1920	28	0	0	28	12	6	33	15	0	35	5	0	35	15	10	38	17	6	38	17	6	38	17	6	38	17	6	38	17	6	38	17	6	36	17	6	36	17	6	35	14	9
1921	29	1	3	23	5	0	21	12	6	20	0	0	20	0	0	20	0	0	17	5	0	15	0	0	14	4	0	13	15	0	13	10	0	12	18	0	17	5	10
1922	16	5	0	15	13	9	14	0	0	14	0	0	14	0	0	14	0	0	14	0	0	14	0	0	14	0	0	14	0	0	14	0	0	14	0	0	13	4	6½
1923	14	0	0	15	0	0	15	0	0	15	6	0	15	0	0	15	0	0	15	0	0	15	0	0	15	0	0	15	0	0	14	16	0	14	15	0	14	18	3½
1924	14	15	0	14	15	0	14	15	0	14	15	0	14	15	0	14	13	9	14	10	0	14	10	0	14	10	0	14	10	0	14	10	0	14	10	0	14	12	4½
1925	14	10	0	14	10	0	14	10	0	14	10	0	14	10	0	14	10	0	14	10	0	14	10	0	14	10	0	14	10	0	14	10	0	14	10	0	14	10	0

WILLIAM JACKS & COMPANY,

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18, BENNETTS HILL, BIRMINGHAM.
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COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE,
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CHEMIST AND METALLURGIST, with many years' practical Foundry experience, desires post in connection with Foundry; highest references.—Apply Box 566, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

CHIEF FOUNDRY COST CLERK seeks change; 30; seven years' present position; good organiser; intimate knowledge working Repetition Foundry; will accept berth of Manager's Assistant.—Box 576, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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STEEL FOUNDRY MANAGER; disengaged; experienced with the following plants: Siemens, Tropenas, Stock Oil Converter, and eight years' experience with the Electric Furnace Process; understanding the manufacture of Steel Castings from A to Z at a very keen cost of production, either piecework or timework; having also a fair connection; excellent references.—Box 568, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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BUSINESSES FOR SALE AND WANTED.

EXCELLENT COMMODIOUS BUSINESS PREMISES (immediately available) for Sale or to Let in important position in Walsall, containing 4,356 square yards or thereabouts, and formerly used as a Foundry and Engineering Business, but equally adaptable to other trades or industries. The premises can be divided into two portions if so desired.—For further particulars apply E. IRWIN MILLER, Solicitor, Bridge Street, Walsall.

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THE Proprietors of the Patent No. 137,574 for Improvements in Steel Smelting Furnaces are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to HASELTINE LAKE & COMPANY, Chartered Patent Agents, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

PATENT YOUR INVENTIONS, Trade-mark your Goods. Advice, Handbook and Cons. free.—B. T. KING, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.), 146a, Queen Victoria Street, E.C.4. 38 years' refs. 'Phone 682 Central.

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"OLIVER." No. 75. MECHANICAL PATTERN MAKER, and Universal Wood Milling Machine, second-hand, but having had little use, is equal to new, complete with full set of tools, accessories, etc.; great bargain at very low price; photo.—Apply, FRED BROWN & SON, LIMITED. North Road Works, St. Helens.

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FOR SALE.—20-in. and 24-in. Hall's Invincible Sand Mixers; the original and best machine in the market for mixing old and new Foundry Sand, Coal Dust, etc.—Apply, PENNEY & PORTER (ENG.), LTD., Lincoln.

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New 16-in. stroke HIGH-SPEED SLOTTING MACHINE, by Wilkinson, admits in diameter 5 ft.

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SET OF GUILLOTINE SHEARS, by J. Hand & Son, style C.D. No. 3, 36-in blade to cut 3/16 in. thick.

LANCASHIRE BOILER, 30 ft. x 8 ft. 6 in. diameter, reinsure 100 lbs. pressure.

DOUBLE FURNACE ECONOMIC BOILER, 14 ft. x 8 ft., reinsure 160 lbs. pressure.

CATALOGUE (10,000 LOTS) ON APPLICATION.

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Two NEW 40" × 50" OSBORN J405 Rollover Jolters .. .. each £250
Two 18" × 36" TABOR Portable Shockless Rollover Jolters .. .. each £90
Two nearly new 14" × 16" TABOR Power Draft Squeezers .. .. each £60
Two No. 2 DENBIGH Jolters .. .. .. each £18
Two No. 1 DENBIGH Jolters .. .. .. each £15

NEW LADLES—CHEAP.

12 Ton EVANS £95
6 Ton THWAITES £45
3 Ton THWAITES £32

BUY FROM ME AND SAVE MONEY.

ALEX. HAMMOND,
FOUNDRY MACHINERY MERCHANT,
"BOXTED," SLOUGH.

TENDERS.

ARMY CONTRACTS.

Notice is hereby given that tenders for quantities of the undermentioned manufactured goods are invited from time to time as required:—

Metal Trades, etc.:—
Aluminium castings and pressings, Bedsteads, Cutlery, Copperware, Enamelled Ware, Fencing (woven wire and strained iron wire), Field Forges, Hollow-ware, Lamps and Lanterns, Nails, Saddletrees, Sash chains, Scratch Card, Screws, Shovels, Stoves, Grates, etc., Telegraph Poles (iron), Tinplates, Tinware, Tools, Tubing, Wire.

Textile Trades, etc.:—
Blankets, Braids, Buckram, Canvas, and Canvas Goods, Cloth, Cordage, Cottons and Cotton Goods, Cotton Waste, Cotton Waste for Guncotton, Embroidery, Flags, Flannel, Headdresses, Horse Rugs, Hosiery (including Hose tops), Linens and Linen Goods, Moquette, Puttees, Sewing Cotton and Thread, Silk, Sponge Cloths, Stockinette, Tapes, Tents, Webs, Worsted Gloves.

Electrical and Scientific Instrument Trades:—
Cables, Electrical Stores, Scientific Instruments.

General Trades:—
Boots and Shoes, Boxes and Chests, Brushes and Brooms, Candles, Chemicals (including Acetone, Alcohol, Aluminium Powder, Anhydrous Ammonia, Barium Nitrate, Magnesium Powder, Soda), Chinaware, Combs, Cooperage, Earthenware, Furniture, Glassware and Splinterless Glass, India-rubber Goods, Leather Goods, Paint (including paint, zinc oxide, dry), Soap, Stable Fitments, Timber, Vehicles, Woodware.

Manufacturers who are not already on any War Office list of tenderers, and who may wish to be invited to tender for Army requirements of the above stores, should apply to the Director of Army Contracts at the address given below for Form 1, on which formal application for inclusion on the list of tenderers may be made. The services of an intermediary are unnecessary in approaching the Department for this purpose.

Before being placed on the lists of tenderers firms will have to satisfy the Department that they actually manufacture goods for which they wish to be noted, and will be required to furnish the names of at least two well-known firms or public bodies who have purchased from them and are in a position to certify as to the quality of their productions. They will further have to give an undertaking that they will comply with the Fair Wages Resolution of the House of Commons.

Attention is called to the decision of His Majesty's Government that, "save in very exceptional circumstances, all firms contracting for Government Contracts to whom the conditions of membership of the King's Roll are applicable must be on the King's Roll."

SALES.—From time to time the Department has for sale surplus Army stores of various descriptions, among which may be mentioned:—Machinery, Electrical Stores, Hutting, Mechanical Transport, Drugs, Medical and Dental Stores, Veterinary Stores, Laboratory Apparatus. Firms who wish to be invited to tender for the purchase of surplus stores should apply as directed below.

All applications should be in writing, and should be addressed to the Director of Army Contracts, Caxton House (West), Tothill Street, Westminster, London, S.W.1. No application is necessary from firms whose names are already on the War Office lists.

N. F. B. OSBORN,
Director of Army Contracts.

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